Journal of FORESTRY

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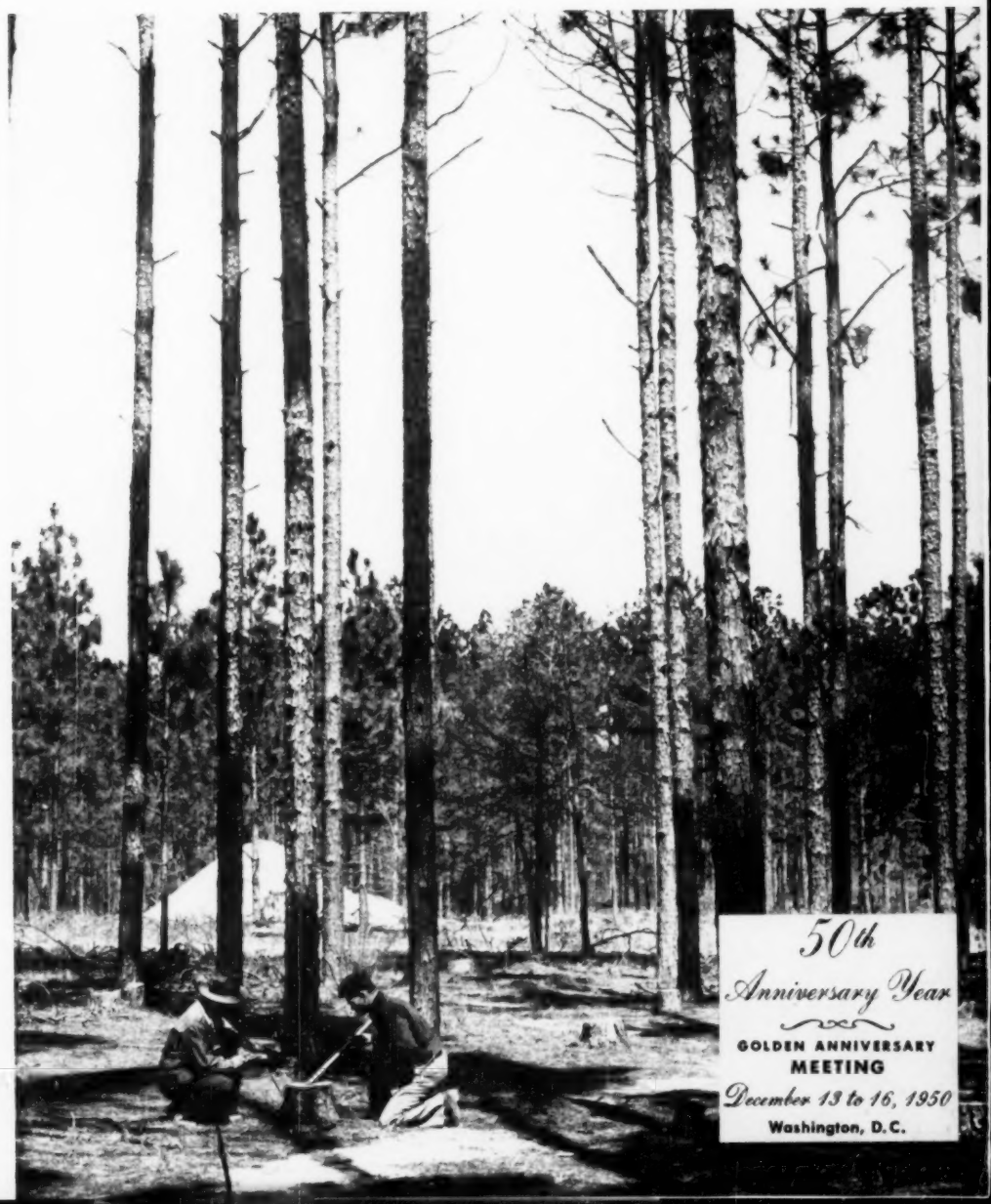

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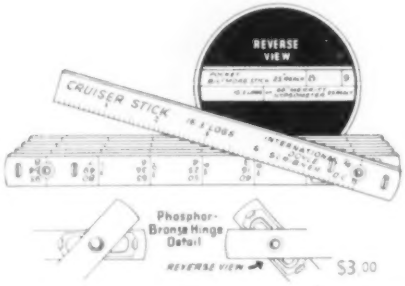

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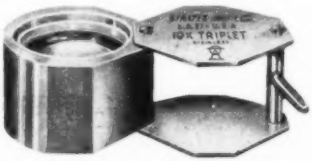

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Journal of Forestry

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Watershed Management: Key to Resource Conservation[1]

Reed W. Bailey

Director, Intermountain Forest and Range Experiment Station, U. S. Forest Service, Ogden, Utah.

No ONE TODAY questions the need for abundant natural resources. They are the foundation for our productive might—the sinews of our national strength. We learned the importance of having an ample supply of resources during the past World War. Because we had them and were able to use them in prodigious quantities we won the victory. Now as we go forward with the dual job of maintaining an ever-expanding economy at home and of helping other nations to assure the peace of the world, our needs for the resources of our watershed lands—food, forage, wood, wildlife, recreational opportunities, and usable water—are greater than ever.

Is there a basis on which to achieve an abundance of these renewable resources? The answer is implicit in the title of this address. Watershed management is truly the key to resource conservation. It even goes beyond this; it is the key to our productivity.

We are fast learning the importance of water to our national well-being. Increasing water shortages, destructive mud, and floods are calling for river regulation and development programs throughout the nation. Billions of dollars are being spent in constructing dams, levees, and canals, and proposals have been advanced for spending many more billions for the same purposes. The promise of a mightier civilization is inherent in these developments and proposals. Because of them, great industries will rise, more lands will be irrigated, and cities and towns will grow and flourish.

However, development of our water supplies and river regulation alone are not enough to assure such a radiant future. Dams and other structural projects, though they may be essential to greater economic growth, are no guarantee of continuing prosperity. We must not be deceived in this. Although we need not fear the structural failure of engineering works, we have had enough experience to know that all can fail—the structures as well as the expanded economy dependent upon them—if our watersheds lose their dual capacity to produce useful "crops" abundantly and to deliver ample, clear, and usable water.

Watershed management has for its objective the maintenance of both the productive and the hydrologic, or water-regulating, functions of the land. It seeks to obtain the greatest possible quantity of food, forage, wood, and wildlife and at the same time make certain that water is yielded with the greatest possible regularity and with the least possible load of sediment.

These two vital functions of the land are completely interdependent although the importance of this interdependence has been too little understood. Throughout the past 300 years emphasis has centered on exploitation of our watershed resources: the production of bumper farm crops, and on the harvesting of timber, forage, and game. Our increasing population and expanding industries clamor for more and more of these products from the land. Meanwhile, management of watershed lands specifically to insure useful runoff has been the exception rather than the rule.

Neglect of the hydrologic aspects of watershed management has brought about unsatisfactory watershed conditions in all parts of the country. Too many forest and range lands have been burned with no action taken to reclothe the slopes by planting and seeding. Too much steep forest land and arid range has been cleared for agriculture; too much abandoned to the elements when crops failed. Destructive cutting of our forests has been too common, with inadequate provision for restocking the stands or for preventing the subsequent erosion of logging skidways, loading areas, and haul roads. And in the forests of the East and South, in the Central States farm woodlots, and in large areas of the West there has been far too much overgrazing by both domestic livestock and big game.

The consequences of these land abuses have been far-reaching. We have not only reduced the productivity of our lands and impaired wildlife habitats but have aggravated already serious problems of inadequate water supplies, destructive floods, and damaging sedimentation.

There is an intimate relation between land condition and hydrologic behavior. This has been recognized by early investigators and more recently thoroughly demonstrated by research.

Regulating stream behavior and maintaining soil stability through land management was advanced as a guiding principle over 40 years ago at a White House Conference by the late great geologist, Dr. Thomas

[1] Presented at the Fifteenth North American Wildlife Conference, San Francisco, Calif., March 7, 1950.

C. Chamberlin. He put it this way: "The key lies in due control of the water which falls on each acre." In support of this principle he went on to say, "The highest crop values will usually be secured where the soil is made to absorb as much rainfall and snowfall as practicable . . . . This gives a minimum of wash to foul the streams, to spread over the bottom lands, to choke the reservoirs, to waste the water power, and to bar up the navigable rivers."

Subsequent experience and research have shown us the wisdom and value of his insight. And today the basis of modern conservation practices is the control of water where it falls as snow or rain. In the course of the last 40 years we have extended our knowledge of how plants and soil are interrelated and how they work in the control of water yielded from the land. Such knowledge has been particularly useful on our watershed lands where the steeper slopes make the control of water of utmost importance.

On the mountainous areas which serve as gathering grounds for water there are many factors which determine the disposition of precipitation, the character of stream flow, and the usability of water. Chief among these are topography, climate, soil, plant cover, and the effect of the utilization of watershed resources.

The watersheds we have inherited from the geologic past exhibit great natural variations in erosion and flood behavior. Their very productivity has also been inherited from the geologic past. In some places the plant cover and soil mantle have not developed sufficiently to exert much influence on the way water is yielded from the land. In such places the normal rate of erosion, sedimentation, and flooding is high. On more extensive areas, on the other hand, a plant cover and soil mantle have developed that exert a high degree of control on the reception and disposition of precipitation, resulting in relatively low normal rates of erosion, in normally moderate peak stream discharges, and in normally small sediment loads. Great changes in these geologic norms can and have resulted where lands have been used unwisely.

Let us examine the part that plants and soil play in controlling the water from rain and snowmelt. Where there is plant cover and a soil mantle, the great bulk of the water yield from a drainage basin occurs as seepage flow. This is water that reaches springs, streams, and ground water basins by sinking into the soil and percolating through the underlying rock mantle. Because it is filtered and delayed on its way, it is generally the most usable flow.

Rain and snowmelt can also leave the land as overland flow. This occurs whenever rain falls or snow melts faster than the water can enter the ground. Overland flow generally constitutes only a small fraction of the annual amount of water yielded by a drainage basin, but it is the most damaging kind of runoff.

Whether a watershed site yields runoff as seepage flow or as overland flow hinges directly on the infiltration capacity of every square foot of watershed surface. Numerous factors, including the amount and intensity of rain, the slope of the land, the porosity and structure of the soil profile, and the kind and amount of plants and litter, affect the capacity of sites to take in water. Each of these factors also has a bearing on soil erosion.

By far the most important of these factors are the plant cover and the soil mantle. Vegetation, whether it be of tree, brush, or herbaceous growth, serves to keep a way open into the soil for melting snow and rainfall. It also abetted by the obstructions put in the way by every trunk, limb, twig, and even the finest leaf intercepts precipitation, cushions the impact of raindrops, and acts as the first deterrent to runoff. The temporary delay so imposed promotes infiltration; it aids in getting rainfall immediately into the ground and thus shackles its erosive energy. Once admitted into the ground, the water sinks through soil spaces to the underlying rock, whence it eventually reappears at lower elevations as clear, unhurried springs that maintain stream flow.

Reduction of plant cover, including the litter on the ground, leads to reduced infiltration rates and to increased amounts of overland flow. When plants and litter are destroyed or thinned, soil is exposed to the direct impact of rain. Detached soil particles seal the soil pores and thus inhibit the entrance of water. The elimination of stems and dead materials on the ground also removes obstacles to the movement of water over the surface. In effect, the hydrologic behavior of the land is greatly altered. Erosive energy is unleashed and water becomes quickly concentrated into peak discharges. Overland flow rushes off the land, and moisture so essential to production of forage and timber is lost.

These effects of the plant cover in getting water into the ground and of keeping soil in place have been the subject of a great amount of study on almost every type of farm land and on a wide variety of forest and range lands. The results have invariably been the same: removal of plant cover and compaction of the soil, by whatever manner, steps up overland flow and sediment loads not by fractions, but on the order of one hundred fold or more.

Scarred slopes across the length and breadth of the land and increasingly muddy streams show that the processes of watershed deterioration have gone far. However, the potentialities for greater damage are tremendous. There still remains on our watershed slopes a mantle of soil and weathered rock material that ranges in depth from a few inches to many feet. In the valleys are soil and fill materials up to hundreds of feet in depth. There is enough of this material precariously balanced on the land to fill all our reservoirs and harbors if it is not kept in place. To keep this soil stable is a job for watershed management. We must stop the processes of deterioration where they are under way and

prevent them from getting started on the remainder of the land.

There is now generally adequate authority at the national, state, and local levels to proceed with a better job of watershed management. Notable among the more recent legislative actions was passage of the Omnibus Flood Control Act of 1936 and subsequent annual reenactments of similar measures.

This Flood Control Act recognizes the importance of controlling runoff the land. It authorized the Secretary of Agriculture to have watersheds examined for condition and to develop and carry out improvements on these lands where such measures would reduce flood and sedimentation damages.

Only a fraction of the watersheds have been surveyed under this act thus far. These investigations, however, have been so distributed over the nation as to sample a wide variety of watershed problems. Though many of these surveys are not yet complete, the data already gathered present a strikingly similar pattern of cause and effect and of needed action. In watershed after watershed the needs are tighter fire control, more intelligent land use—that is, use based on ecological requirements—and restoration of plant cover and soil stabilization on a large scale.

Fire control has long been recognized as an essential conservation measure. Destruction of timber, forage, and wildlife by fire is always tragically impressive and the public has been willing to make funds available on an increasingly generous scale to combat the fire menace. However, two major deficiencies in fire protection need to be corrected if we are to achieve satisfactory watershed conditions.

One of these needs is to extend organized fire protection to the 100 million or so acres which are not yet receiving it. Another is to step up the intensity of fire control on watershed lands where there is a high hazard of erosion and floods. In too many places, fire control standards have been based solely on the need for protecting timber or forage without adequate consideration of requirements for flood protection. Where downstream values are great and need protection from floods and sedimentation, there may be ample justification for setting up the most rigid control of fire, even to its elimination, if possible. Every citizen has a responsibility to make certain that watershed lands in his own locality are getting enough protection from fire to preclude the possibility of destructive floods and damaging sedimentation.

A much more difficult problem than that of getting fire control is getting more conservative and intelligent use of our watershed lands. The difficulties are both sociological and technical. It is a complex job that is going to require more research as well as accelerated action.

Owners of several million forest properties are concerned about getting a profitable cut of timber from their holdings. Many of these people together with many thousands of livestock operators are also interested in the profitable use of forage in the woods and on the range. More millions—and their ranks are growing—want full game bags and more outdoor recreational facilities. These are legitimate and understandable desires. Uses of watershed land resources are of tremendous economic importance; from them, in fact, will come the only economic return we can expect from about two-thirds of our land. The growing needs and demands for resources make it all the more urgent that ways and means be found for keeping use at a level that will insure their sustained yield as well as control of runoff and soil loss.

We have learned through research that moderate levels of use not only protect the resources but that they often increase production. We have found, for example, that on moderately grazed range, cattle and sheep make better gains than on heavily grazed range, and that plant species heretofore suppressed almost to disappearance begin to increase. With increased vigor and denser growth, the plants are able to provide more ground cover and protective litter. Nevertheless, past misuse necessitates much lighter use of the range in many localities and even nonuse on some of the steepest and most readily damageable lands. Similar adjustments must be made in the handling of some timber lands. We know also that road building can be highly disruptive of watershed functions and that roads should be carefully planned and constructed with attention given to soil stability and runoff control.

We know enough to go ahead with needed land use adjustments on a broad front. Our landscape, however, provides an almost infinite variety of differences of climate, topography, soil, and plant cover which in turn have different watershed protection requirements. Management must therefore be applied place by place and must have as its basis a thorough ecological understanding. Although we have discovered the protection requirements of many sites, we do not have detailed answers for all conditions. Here lies a broad field for further research—determining how and to what extent such lands can be used with safety.

The greater part of our depleted lands can be restored to productive levels through adjustments in use. Some, however, have been so badly misused that more intensive kinds of treatment are necessary if they are to be rehabilitated. There are millions of acres of forest land that are virtually barren of timber and still more millions of acres of range land that are badly depleted. Much of this land can be restored to usefulness by planting or seeding. We have the knowledge to proceed with this work in many places. Some tree planting and range reseeding is now going forward but at a pace that is far too slow. It must be speeded up. We must also quicken and expand research on finding cheaper planting methods and species of plants that will thrive on badly eroded lands.

Some of our sick land has lost so much soil and is so actively eroding that planting alone is not going to be enough to stabilize slopes and retard runoff. This land

is going to require mechanical aids in the form of terraces, contour trenches, gully plugs, and the like. These are costly measures but the longer their application is delayed, the costlier the ultimate job becomes.

In addition, in all sections of the country there is mile upon mile of stream channel that has been ripped to many times its normal depth and width by flood discharges from upstream. Some of these channels will become restabilized when discharges from the slopes are brought under control. Many, however, have so deeply undercut the watershed slopes and valley fills that even small streams of water will continue to cause further channel deepening and widening and consequently increased sediment loads in streams. The job of stabilizing eroding channels on the tributaries of major rivers has scarcely begun. Here again, is another problem area in which we have developed enough knowledge to start action but where many technical difficulties can be overcome only by more research.

In summary, the concept of watershed management is relatively new even in the youthful conservation movement. It is a broad concept affecting all of renewable resources and applicable over all the land. It is a dynamic concept that envisions the fullest use of wildland resources and at the same time provides for maintaining maximum yields of usable water from the land.

We have taken a few halting steps toward accomplishing the goal of better watershed management. Much is still to be done. There must be, first of all, continuation and intensification of "action" programs which will apply what we already know about the protection, maintenance, and restoration of our watershed lands. Second, we need a wider background of research results for developing even more effective action programs. Third, and by no means least, we need to build a public understanding of the importance of maintaining our watersheds in good condition and of the relation of watershed management to resource conservation.

To attain these aims is certainly a long-term job. There is much at stake. The condition of our watersheds determines not only whether we conserve our resources but whether we shall have them at all. Poor watersheds mean a progressive lowering of resource production and with this a poorer economic life. Good watersheds mean a continuously high level of resource production. They are essential to an abundant and secure economic life now and in the future.

Influence of Nail Head Size and Slat Thickness on Pull-Through Resistance of Colorado Woods[1]

A study was made of the influences of nail head size and slat thickness on the pull-through resistance of seven species native to Colorado to evaluate them in terms of suitability for box and crate construction. Pull-through resistance was defined as the force required to pull a nail head completely through the slat.

The effect of nail head size was studied by the use of three sizes of nail heads, corresponding approximately to those of threepenny, fourpenny, and sixpenny box nails. The influence of slat thickness was studied over a range of from $^{7}/_{32}$-inch to $^{11}/_{32}$-inch. Tests were made in the center portion of slats as well as near the ends.

Arranged in order of decreasing resistance to nail head pull through the species tested were: lodgepole pine, quaking aspen, ponderosa pine, Douglas fir, lanceleaf cottonwood, Engelmann spruce, and alpine fir.

Pull-through resistance varied in almost direct proportion to the slat thickness and the nail head area. However, only a small range of these two variables was studied. The slats usually had a greater resistance when the nail was placed in the middle of the slat than when placed near the end of the slat. Increases in nail head area or in slat thickness were more effective in causing greater pull-through resistance in the middle of the slats than near the ends.

A standard, or desired, strength requirement was taken as the resistance offered by a $^{1}/_{4}$-inch ponderosa pine slat to the pull-through of a threepenny box nail. If other species are used, the pull-through resistance equivalent to ponderosa pine can be obtained by changing the nail head size or slat thickness.

RAY J. BOYD,
Colorado A & M College
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[1] Abstract of Masters thesis, 1950.

Increased Uses for Wood on the Farm

Arthur C. McIntyre
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Upper Darby, Pa.

The author believes that chipped wood can aid agriculture in a number of ways. Research has determined that sawdust or shavings will improve soil structure and produce long-life humus, provide a good mulch, and make acceptable animal bedding or chicken litter. Portable wood chippers are now available for use by farmers. Costs, per ton use, of wood chips are less than the costs of material they could replace. The possibilities for the use of fragmented wood on farms offer a real challenge to foresters.

IN AGRICULTURE, there are four primary needs for organic matter that can be satisfied by using wood in a fragmented form. These are (1) soil organic matter, (2) mulch material, (3) chicken litter, and (4) animal bedding.

The most common use of fragmented wood in farming is as sawdust and shavings, preferred material for animal bedding. But the volume of available sawdust or shavings is limited, and in some sections may be in such short supply and so high priced that not much use is made of them. Wood chips may be a suitable substitute.

Wood for Soil Organic Matter

Organic matter is essential to a "healthy" productive soil. Its value has been so frequently stated that it needs no repetition here. Of the two forms of humus, nutrient or "readily decomposable" humus is easily broken down and principally serves micro-organisms as a source of carbon. Long-life or "resistant" humus, as the name implies, represents the humus capital of soils.

The maintenance or building up of long-life humus in our soils is the most important requisite to good soil husbandry. Crop rotations, green manure crops, and the application of animal manures are all directed toward maintaining humus in the soil. On an average, the percentage of humus in farm soils has decreased. In the corn states, where virgin sods contributed quantities of organic matter, over half of it has been lost in less than one hundred years of farm use. This is a serious condition, for not only do soils decline in productivity when devoid of humus, but as the humic material disappears the soils become more erodible and have reduced infiltration rates.

Good soil husbandry, the improvement of farm lands, requires the increase and maintenance at a high level of the humic content of food-producing land. There is no likelihood of animal manures being available in sufficient quantities to meet demands. Green manure crops contribute little or no long-life humus; they are high in cellulose and must be considered only as contributors to temporary or nutrient soil humus.

But wood is readily available to approximately two-thirds of our farmers. Wood can build up impoverished soils and aid in maintaining the humus content.

Numerous comprehensive studies have been made on the use of wood as a soil amendment. They have shown that sawdust may have beneficial effects when mixed with any soil, provided the nitrogen supply is adequate or is supplemented with sufficient nitrogen to offset the probable depressive effect of the sawdust. Research in the use of sawdust established the need for adding a high nitrogen fertilizer such as $(NH_4)_2SO_4$ at the rate of about 60 pounds per ton of dry matter. This nitrogen requirement applies, however, whenever most organic materials are mixed with soil, because the organisms responsible for decomposition require nitrogen for food in making protein for their own bodies.

The mixing of sawdust or shavings into soil, especially into heavy soil, materially improves its physical properties. The capacity of the soil to take in and hold water is improved. In the spring, sawdust at the rate of $7\frac{1}{2}$ tons per acre was plowed into a nursery soil. In the fall, laboratory tests on random samples showed that for the sawdust plots, water-stability was 70 percent as contrasted to about 16 percent for the nontreated plots. The crops of black locust seedlings and sudan grass on the sawdust plots were comparable to the check plots. When the plots were fall-plowed the workmen reported marked difference, with the soil on the sawdust plots turning easily and having excellent structure.

Adding organic material to a light (sandy) soil gives it body and the ability to retain moisture. Because wood chips will not decompose as rapidly as sawdust it can be assumed that their use would be preferred because of longer lasting beneficial results.

Humus is high in lignin. It is referred to as a ligno-proteinate. Studies in the use of lignin on soils have shown that it imparts desirable physical characteristics. Heavy soils with little humus and low water intake capacity were so improved by incorporating lignin that infiltration rates were increased to the point where heavy rains did not produce a ponding effect, as contrasted to nontreated check plots. Lignin tends to accumulate in the soil. Thus, the incorporation in the soil of plant tissue high in lignin will tend to build up long-life humus.

The chemical composition of wood varies somewhat by species. On the average it contains about 60 percent cellulose, 28 percent lignin, 1 percent mineral; and the remainder, 11 percent, is made up of waxes, resins, terpenes, etc. The high lignin content of wood, as compared to other organic materials, makes wood a soil organic supplement of high value.

The fertilizer value of wood is low, averaging about 4 pounds of N, 2 pounds of P_2O_5, and 4 pounds of K_2O per ton. Straw is about 12-4-18.

That soil can absorb large quantities of wood and thus improve in productivity has been proved by those farmers who, for over twenty-five years, have used large quantities each year. The results of a number of experiments with the application of sawdust and shavings to the soil suggest that as much as 20 tons per acre of these materials may safely be worked into the soil if adequate amounts of a suitable nitrogen fertilizer are also added.

The old wives' tale that wood sawdust produces excessive soil acidity has little merit. Softwood sawdust contains less basic material than hardwood sawdust or most strawy materials. Upon decay, most of the organic acids are used by organisms or lost into the air leaving a neutral or alkaline residue. It should be remembered that plant ashes are alkaline. Sawdust from certain tree species contains large amounts of tannins and terpenes, but these are rapidly destroyed by soil organisms.

Wood Chips for Mulch

Sawdust and shavings are very acceptable mulching materials. They have been used by nurserymen, orchardists, and vegetable and berry growers.

Mulching is gaining in popularity. Increased yields have followed the use of mulch, and soil erosion has been effectively controlled.

There are many reasons why mulching is a good practice. The implied meaning of the practice is to provide a cover to the soil so as (1) to reduce soil temperatures and thus also conserve moisture by preventing or hindering evaporation; (2) to absorb the energy of rain-drop impact thus reducing erosion; (3) to insulate soil against early or quick freezes, thus protecting worm populations; (4) to keep the surface of the soil loose and friable, thus increasing penetrability of water and retarding run-off; (5) to keep down or eliminate weeds, grass, or other vegetation, thus reducing the competition for soil nutrients and water between the commercial plants and those not wanted; (6) to protect plants from winter injury; (7) to protect berries from dirt spattered by rain or to cushion the fall of fruit from trees; (8) to keep soil from compacting under weight of machinery; and (9) on heavy wet soils to permit use of spray machinery at critical times.

Wood chips can meet all these requirements. Because of certain physical properties, their value as a mulch material may greatly exceed that of any material now in use.

Wood for Poultry Litter

Large quantities of peanut hulls, ground corn cobs, chopped corn stalks, cottonseed hulls, sawdust, shavings, and similar materials are used each year in poultry houses, especially by the broiler industry. Sawdust and shavings have been found satisfactory. At many agricultural colleges, wood shavings are used in preference to other materials.

Cost of litter is an important item. An objection to the use of sawdust is that it packs. Shavings also tend to break up and pack. But coarse wood chips appear to be an ideal form of litter. Chips will not pack, and as they are trod upon they tend to flip over and thus remain loose and dry. The larger chips remain on top of the three inches or so of litter, while the smaller particles and wastes sift to the bottom, which is a highly desirable condition.

Wood for Animal Bedding

Bedding is used primarily to furnish a clean, comfortable place for animals to lie down. It soaks up the liquid portion of the manure, thus preventing its loss through seepage and drainage. It helps to keep animals clean. When applied to the land, it increases the organic matter content of the soil.

Adequate bedding pays dividends in the dairy stable. It keeps cows cleaner, drier, and warmer. Whether sawdust, shavings, straw, or old hay should be used as bedding, depends primarily on their cost and availability.

Of the many studies on bedding materials in dairy stables, that which covered the longest period was conducted at the Agricultural Experiment Station of the Rhode Island State College. Straw bedding manure was compared with sawdust or shavings bedding manure over a period of 18 years. This long time study showed that "no detrimental effects to the land have resulted from the shavings or sawdust bedding as compared with straw."

Sawdust will absorb at least twice as much liquid as will straw, and shavings about the same amount as straw. It can be expected that fine wood chips would also have acceptable absorbent capacities.

Farmers who have used sawdust or shavings for bedding report that they are easier to handle than other materials.

A Wood Chipper

It is obvious that if wood is to be accepted for use as bedding, litter, mulch, or soil organic supplement, it will have to be converted to a fragmented form of a size and at a cost to meet general approval. This can be done by chipping machines. Several light portable wood chippers that give promise of meeting requirements are being manufactured.

These machines weigh about two thousand pounds. Mounted on rubber tires, they can go wherever a jeep or truck can be driven. They can be moved into the farm woodlot where the limb wood and pole-wood are converted into chips and blown directly into a truck or wagon for hauling to the place of use. The machine can be set up at the barn or chicken house, wood hauled to it, and the chips thrown directly into storage. It can be hauled through the orchard. Prunings, directly reduced to chips, can be blown into place for mulch. The mobility of these chippers adapts them to a variety of uses.

A chipping unit can be readily mounted on the front of a tractor and driven by belt from the power take-off. Thus mounted, it can move in wherever the tractor can be driven.

The Water Supply Board of Providence, R. I., purchased a chipper to facilitate removal of thinnings from plantations and accumulated debris along rights-of-way. Piling and burning had been the practice. With the chipper, cost were materially reduced, but of greater importance was the flexibility in labor work load. Burning could be done safely only during a few days of the year. Using the chipper, workers can reduce fire hazards any time during the year, thus efficiently employing small labor crews. The chips are blown directly on the ground where they are not a high fire hazard and, in a few years time, they disappear into the forest floor.

The chipping head is a cylinder $11\frac{3}{4}$ inches in diameter upon which are mounted four knives. It is designed to rotate at about 2,200 r.p.m. A movable bed plate operates against two coil springs, holding wood snugly against the knives. A steel plate instead of a cylinder has also been used.

Machines in use are designed to chip pole or limb wood up to five inches in diameter. This size wood feeds automatically through the machine. A 30-horse power motor is used. A larger machine has been built and is now being tested.

The knives can be adjusted on the head so as to produce a relatively coarse chip or one paper thin. With toothed knives, product like a coarse sawdust can be made.

There is a safety hazard in using the chipper, but with a long apron the likelihood of a workman sticking his arm into the knives is greatly reduced.

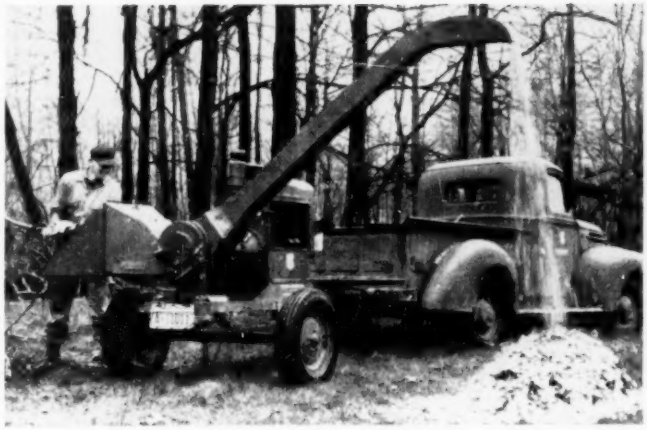

FIG. 1.—Wood chipper converting small branches into woodchips.

Production and Costs

The capacity of the wood chipper is in excess of 2 cords of pole wood, (diameters under 5 inches) per hour, with two men feeding. Limb wood, as measured in windrows, has been converted to chips at the rate of 4 cords per hour, with four men feeding the chipper.

The cost of operation for a chipper and mounted power unit has been computed at $1.50 per hour of machine operation. This cost includes depreciation (4,000 hours), maintenance, and operation.

A breakdown on cost would be about as follows assuming basic cost to be:

Stumpage for pole wood or cost of slash	per cord	$1.00
Labor cost	per hour	1.00
Operation of chipper	per hour	1.50

Two cords of wood will produce about 4 tons of chips. Two cords of poles can be cut up in one day by an axeman at a cost of $8. Two men feeding poles into a chipper, plus cost of machine operation, would be $3.50 per hour. Thus, the cost of 4 tons of chips would be $11.50, or less than $3 per ton. If the pole wood were hauled to the chipper, which might be located at the barn or in the orchard, hauling cost per ton might be $2. Chips can be blown directly on a truck or manure spreader, hence handling costs of chips from woods to point of use should not be more than $2 per ton. Total cost of chips at place of use should not be more than $6 per ton.

Wood Chips and Forestry

Research has established that wood in the form of sawdust or shavings is acceptable for use as bedding, litter, mulch, or soil organic supplement.

Neither sawdust nor shavings is available in volume to meet even a small fraction of agricultural needs. To meet the needs, wood can be chipped to a size to satisfy specific requirements. A tremendous tonnage of wood is lost or wasted each year. The harvesting of wood to be chipped need not be done at the expense of growing stock, but rather such harvesting can be done to improve both quality and growth rates.

On the farm stand, improvement could be done and a two-way profit realized. This may be one of the answers to the forester's often asked questions, "What can be done with the nonmerchantable trees and unused portions of slash?"

An average 20-acre farm woodlot can be expected to produce about 40 tons of wood per year. In the sapling or pole stage most of this growth can be harvested at a benefit to the stand. As trees attain merchantable size salable products should be harvested, but even with the removal of such material many tons of wood can be withdrawn for chipping.

Forty tons of chips would care for the needs of a twenty-cow dairy. This amount of organic material, used as a mulch in an apple orchard, would provide for initial mulching of about 200 trees, or maintain the optimum amount of mulch in a 25-acre orchard. The application of 40 tons of chips to 5 acres of plowland would be

equivalent to plowing down a green manure crop that had been maintained at least 1 year in rotation.

While considerable literature is available on the various uses of sawdust and chips in connection with farming enterprises, there is need for specific information on how to use wood under a given set of soil or climatic conditions. Some new research is underway at several state colleges, but there should be studies undertaken at more of them. If wood is to come into general use by farmers there must be more discussion of values. Extension workers, county agents, conservationists, and foresters will have to become informed.

With interest and public demand, many efficient chippers will be developed, costs further reduced, and wood will become of greater service.

Foresters can have a part in this development by encouraging colleges and experiment stations to initiate studies. As a pay-off we can look forward to the time when utilization of low-grade or cull material may not be quite the problem it is today.

Invasion and Development of Natural Vegetation on Spoil Banks in Central Pennsylvania[1]

The study has been focused on the natural vegetation found on spoil areas varying in age from 1 to 29 years, which have resulted from stripping of bituminous coal in central Pennsylvania. The spoil consists predominantly of mixed thick-bedded and thin-bedded nonpyritic shales. The soil content is 20 to 40 percent with a pH range from 3.5 to 5.5.

A systematic study of the plant communities on nineteen different spoil banks has been used for compiling a description of the ecological pattern of the invasion and development of the spoil bank plant community. A proposed name for this plant community is aspen-fire cherry-blackberry community. The characteristic species are trembling aspen, big-toothed aspen, fire cherry, red maple, blackberry, asters, sedges, poverty grass, panic grasses, goldenrods, cinquefoil, and barren violet. They are likely to be represented in practically all plant communities which develop under natural conditions on spoil banks in this area. Some other species may be prominent on one spoil bank, but they do not occur with enough regularity in spoil bank communities to be considered characteristic community species.

The value of cover furnished by the community is very limited and is inadequate to hide the ugliness of the spoil. On most banks, when 10 years old, the cover will be less than 50 percent. The lack of evergreens makes the spoil particularly prominent in the winter. Because of their poor form and low value, the main tree species present (aspen, fire cherry, and red maple) offer little or no hope for a timber crop.

A theory has been developed that the spoil areas of the type studied are most susceptible to invasion by natural vegetation during the first 2 to 3 years after stripping. After this time, at least for the next 25 years, they are less susceptible to invasion. Surface adversity develops by the formation of a stony, shingle-like roof through soil eluviation. Shaly spoils with low soil content develop the severest conditions. The severe conditions kill any potential invader before they can establish themselves. The conclusion drawn from this theory is that the success and the make-up of a spoil bank plant community is determined within the first 3 to 4 years after stripping. If at this time, barren areas are still present, they are not likely to be occupied by any succeeding waves of invaders for at least 25 years.

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[1] Abstract of Master's Thesis, The Pennsylvania State College. 1950.

Soil Pore Space and Aeration in Several Forest Communities in Central Iowa[1]

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and A. L. McComb

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This paper describes some of the soil factors, primarily soil porosity and atmosphere, that may be directly associated with the composition and growth of hardwood forests in the Central States.

AMONG THE numerous soil factors affecting tree growth and distribution the physical soil properties relating to moisture availability and aeration seem, on the basis of present knowledge, of first importance[2]. Soil and profile characteristics of great importance are thickness of the A horizon, thickness of the B horizon, silt and clay content, compactness and plasticity, permeability, degree of oxidation and reduction, color, thickness of the soil mantle above bed rock or other impervious strata, air space, and total porosity (*1, 2, 7, 13, 14, 15, 16, 20, 21, 22, 23, 24, 25, 26*). Various authors have stressed the importance of studying the entire soil profile to the depth penetrated by tree roots.

A deficiency of air space in a soil tends to have a deleterious effect on tree growth. As air space is provided by noncapillary pores that are empty of water when the soil is at the field capacity, a minimum of such pores is associated with soil compaction (*13*), with mechanical resistance to root penetration (*8*), with greater moisture retentiveness (*13*), and with poor aeration (*3*). Russell and Appleyard (*19*) pointed out that there are actually two different atmospheres in the soil, one present as free gas in the large pores, the other consisting of the gases dissolved in the water film about the soil particles; the former high in oxygen and the latter almost pure carbon dioxide. Boynton and Compton (*3*) found in northeastern United States that the oxygen percentage in gas from heavy subsoils is normally low in early spring and increases during the year; they concluded that accumulated precipitation, soil texture, compaction, and depth were decisive factors in determining the minimum oxygen level and its duration.

It was early discovered that roots of different species responded differently to varying soil aeration (*5*). An increase in carbon dioxide or a decrease in oxygen, both of which normally occur simultaneously, causes reduced water and nutrient absorption (*6, 11*), poor root penetration, and poor growth (*4, 18*). Heinicke (*10*) states that some root regeneration may occur in an atmosphere of 5 percent oxygen but that such a concentration is definitely below the optimum for trees. According to many authors it seems that less than 5 to 10 percent oxygen or more than 10 to 20 percent carbon dioxide in the soil will seriously limit plant growth.

The present paper describes five forested areas in central Iowa from the standpoint of forest composition, soil porosity, aeration, and several other factors.

Areas Studied

The five areas studied are in Boone and Story counties. Each area is in a distinct soil type representing the most important forested soils in central Iowa. Forest composition was studied on 1-acre sample plots. Within each area a trench 5 feet deep and 6 feet long was dug from which the soil profile was described and root counts made. Adjacent to the trench, soil samples were taken for detailed analysis, and some 25 to 50 feet from the trench the apparatus for extracting soil gas samples and for determining water-table levels was installed. A general description of the forest and soil from each area follows.

Plot I was located on Wabash loam along a stream bottom. The forest stand consisted of black walnut and hackberry with some American and red elm, shagbark hickory, white oak, and green ash. The soil was dark brown to black throughout with very slight graying with depth. It had a good crumb structure and no pronounced horizon development or clay accumulation within the 5-foot depth studied. The area was flat and subject to occasional seasonal flooding, generally of short duration. Internal soil drainage was excellent, except during the short periods of high water table.

Plot II was located on an undescribed alluvial bottomland soil along the Des Moines River. This bottomland floods annually, frequently the floods are of long duration and thin layers of fine sand and silt, or rarely clay, are deposited periodically. This plot was 9 feet above the river level, and ground water was seldom more than 5 feet from the surface. The principal tree species were cottonwood and black willow with some silver maple, American elm, and boxelder.

Plot III was located on Dickinson fine-sandy loam, a soil formed from coarse textured, water-sorted glacial materials at the top of a slope 100 feet above a small creek. Due to coarse surface texture, gravel in the lower horizons and location on the slope, the internal drainage of the soil was excellent. The slope varied from 2 to 5 percent. There was no natural forest on this area but catalpa and several species of pine had been planted. The catalpa was not developing satisfactorily but adjacent white and red pines were making excellent growth.

Plots IV and V were similar in forest composition, the principal species being white oak, black oak, and shagbark hickory. Both were on soils developed from fine-textured, late-Wisconsin (Mankato) glacial materials. Plot IV was in the Ledges State Park; the soil

[1] Journal Paper No. J-1675 of the Iowa Agricultural Experiment Station, Ames. Project 967.

[2] Baver, L. D. Practical values from physical analyses of soils. Soil Sci. 68: 1-14, 1949.

TABLE 1.—SUMMARY OF STAND DATA FOR FIVE PLOTS

Type or stand	Plot No.	Age	Height dominants	Av. stand diameter	Trees per acre[1]	Basal area per acre[1]	Total volume per acre[2]
			Feet	*Inches*		*Sq. ft.*	*Cu. ft.*
Bottomland hardwood	I	86	75	20.0	51	88	2386
Cottonwood plantations	II	38	71	11.9	228	94	2609
A. Catalpa	III	37	37	7.9	575	149	2489
B. White pine		25	46	7.0	620	165	2735
White oak black oak hickory	IV	69	55	10.7	377	82	1529
White oak black oak hickory	V	78	57	12.9	356	104	2007

[1]Trees 0.6" and up. [2]Trees 2" and up.

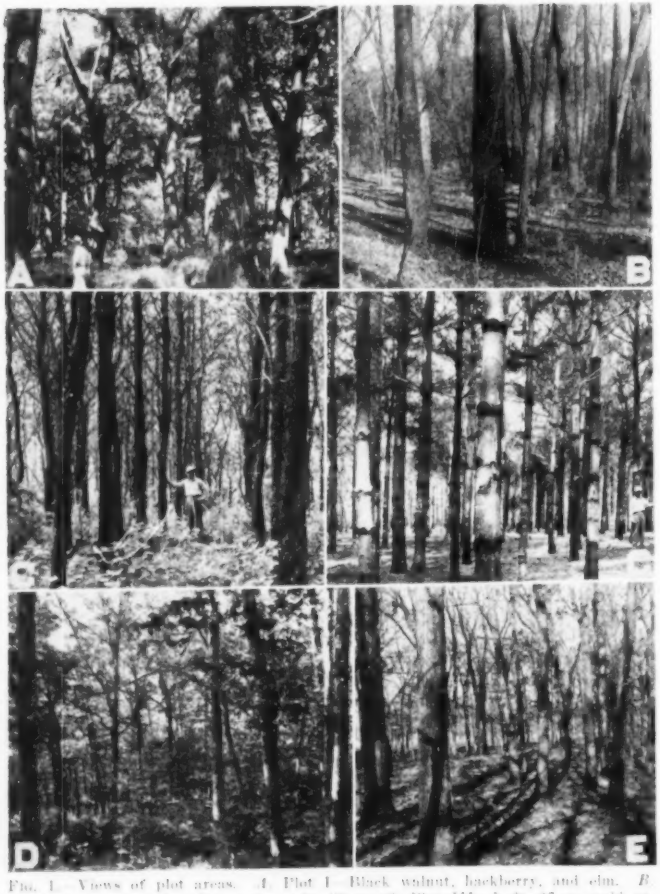

FIG. 1.—Views of plot areas. *A*. Plot I—Black walnut, hackberry, and elm. *B*. Plot II—Cottonwood, soft, maple, and willow. *C*. Plot III—Left, 37 year old catalpa; right, 25 yr. old white pine. *D*. Plot IV. *E*. Plot V, both with white oak, black oak, and hickory.

was Ames fine-sandy loam, a planosol developed on level topography from calcareous parent material. Internal drainage was very poor. The Ames soils are frequently characterized by perched water tables. The soil on Plot V, which is located east of the Skunk River northeast of Ames, developed under forest vegetation on the heavy-textured Mankato till on a slope averaging 5 to 15 per cent. It is now mapped as Hayden. The surface drainage is good but the internal drainage poor. Some recent grazing had occurred on Plot V, but none within the last 20 years or more on Plot IV.

Experimental Procedures

Soil analyses were made on samples collected from, or adjacent to, the trenches that were dug to describe the profiles and make the root counts. Wherever practical, samples were taken from each horizon. Soil porosity and volume weight were determined by the method described by Lutz (*12*), with duplicate samples taken in open steel cylinders. Other samples were analysed for organic matter by the wet combustion method, pH by the Beckman glass electrode, and a mechanical analysis was made by the Bouyoucos hydrometer method.

Root counts were made on the face of each trench to determine if there was a relation between root concentration and soil horizon characteristics. Roots were divided into five size classes, but these were later pooled, as 97 percent of all the roots fell in the smallest (<0.05-inch) class. The concentration of roots in each horizon was then computed.

Samples of the soil atmosphere were collected at weekly intervals over a 1-year period from the 1-, 3-, and 5-foot levels on each plot. Permanent gas samplers constructed of 1/4-inch copper tubing fitted at the lower end with a 1/3-inch by 3-inch perforated bronze cylinder loosely packed with rock wool were used. These tubes were sunk vertically to the required depth and the area above the cylinders packed tightly with

puddled soil. The tubes were fitted at the upper end with rubber tubing and screw clamps. As all analyses were made in the laboratory using an Orsat-Muencke gas analyser, the gas samples were collected in 300 ml. collection bottles filled with a saturated salt solution. A distinct disadvantage of this system is that samples cannot be collected if there is water in the soil tubes, so that no data are available to represent the soil atmosphere under the most critical conditions of water-logging and aeration.

Results and Discussion

Some basic data regarding the stands on the five areas are given in Table 1 and the areas illustrated in Figure 1. The stands, excepting plots IV and V, are not comparable because of differences in composition, density, and age.

The relation of pH to depth varied for each of the five soils. The Wabash soil of Plot I, which was very uniform throughout, showed practically no variation in reaction; throughout the whole profile the pH values were about 7. The many strata of alluvium of Plot II showed pH varying from 7.5 at the surface to 6.2 at the 4-foot depth, with the average slightly below neutral. The reaction profile of the Dickinson soil on Plot III is typical of a gray-brown podzolic or prairie soil formed from coarse-textured calcareous parent material in that there is an abrupt drop from pH 6.5 at the surface to 5.1 in the well-leached, acid A_2 horizon. The pH values at the 3-foot level and below were 8.5 and higher, due to the calcareous sandy-gravelly parent material. This material comes to the surface several hundred feet down the hill from the catalpa plantation where planted red, jack, and Scots pine have failed or are chlorotic and severely stunted. Plots IV and V were characterized by an A_1 of 6.3, a B of 5.5 to 6.0 and a C horizon of 7.5 for Plot IV and 6.0 for Plot V.

The concentrations of all roots in the various horizons of the five soils are shown in Table 2. The highest concentration of roots always occurred in the upper few inches of the A horizon and there was a steady diminution with depth. High concentrations in the upper horizons were generally associated with greater pore space, improved aeration, and high organic matter content. Where there were fewer roots the soil contained less organic matter and was generally more compact and more poorly aerated. The greatest concentration of large roots occurred in the B_2 horizons. The greater root concentration in the A_1 horizon of Plot IV as contrasted to Plot V was due to the more abundant ground cover of Plot IV.

Data on air space, total pore space (air space + water at field capacity), and inorganic and organic solids are given in Figure 2. All data are volumetric except organic matter which represents a percentage of the weight of the total volume of solids shown. The data show high organic matter content associated with large total pore volumes, high field capacities, and with low soil volume weights. The highest organic content was found on Plot I which represented a good site for black walnut; the lowest in the soil of Plot III which supported rapid growing stands of red and white pines but poor stands of catalpa.

In the following discussion of aeration conditions it is well to note (Fig. 2) the greater volumes of large pores in Plots I and III and the greater depth to which this air space is carried. This improved ventilation capacity seemed to be the result of the excellent crumb structure, probably a result of the high organic matter in Plot I, and of the presence of coarse sands and little colloidal material in Plot III. It is also interesting to note the diminished pore volume, particularly the smaller air-holding capacity, of Plot V as compared to Plot IV. As Plot IV had been fenced against grazing for some years, while Plot V had been moderately grazed throughout the summer months, there was some evidence of the compaction brought on by this practice. In almost all other aspects the two soils were much alike in the surface foot. Plot II, being the product of almost annual alluvial deposition, was somewhat difficult to analyze correctly with the large sampling cylinders used. The rather high macro-pore volume was probably a result of the considerable amounts of undecomposed organic materials buried by the flood deposits, as well as the pockets of sand found throughout.

TABLE 2. DISTRIBUTION OF ALL ROOTS BY HORIZONS FOR FIVE FOREST SOILS

Plot I		Plot II		Plot III (Catalpa)		Plot IV		Plot V	
Horizon and depth	Av. no. of roots per sq. ft.	Horizon[1] and depth	Av. no. of roots per sq. ft.	Horizon and depth	Av. no. of roots per sq. ft.	Horizon and depth	Av. no. of roots per sq. ft.	Horizon and depth	Av. no. of roots per sq. ft.
Inches		*Inches*		*Inches*		*Inches*		*Inches*	
A1 0-2	949	1 0-5	375	A1 0-2	1038	A1 0-2	1044	A1 0-2	626
A11 2-6	515	2 5-7	131	A11 2-10	663	A11 2-4	492	A11 2-4	474
A2 6-36	143	3 7-17	250	A2 10-16	362	A2 4-15	208	A2 4-30	147
B2 36-58	62	4 17-21	139	B2 16-26	275	B2 15-42	164	B2 30-48	82
B3 58-60	58	5 21-27	101	C1 26-34	260	C 42-60	18	C 48-60	72
		6 27-35	138	C2 34-46	255				
		7 35-47	72	C3 46-50	89				
		8 47-48	47	C4 50-52	52				
		9 48-52	28	C5 52-56	87				
		10 52-60	11	C6 56-60	50				

[1]No true evolutionary profile present.

In the investigation of soil gases several general trends appeared. During the drier parts of the growing season carbon dioxide and oxygen made up approximately 20 percent of the soil air; thus the soil air is comparable at these times with the normal atmosphere above ground. As the carbon dioxide content rose the oxygen content fell. However, as the carbon dioxide content increased, the sum of the carbon dioxide and the oxygen diminished from the 20 percent average found in dry soils. In general it was found that the oxygen content was lowest when the soil was flooded, when root activity was at its peak and, with other conditions being constant, when large quantities of semi-decomposed organic matter were present in the soil.

The oxygen and carbon dioxide content of the soil fluctuated regularly with seasonal and climatological changes. If the soil was frozen or very dry, the oxygen content was high. On the other hand warm, wet soils produced large amounts of carbon dioxide, probably because of the accelerated activity of microorganisms and roots. Since the interflow of gases between soil and air was impeded by the filling of the airholding pores with ground water, anaerobic conditions soon developed. Such conditions were more evident in the lower horizons because of poor ventilation in the compacted horizons and the higher water content of those strata.

The soil of the high bottomland hardwoods, Plot I, was excellently aerated through all levels for most of the year. From August through mid-March the oxygen content ranged from 17 to 20 percent and the carbon dioxide content from 0.5 to 2 percent. In mid-April and June complete submersion of the soil brought about semi-anaerobic conditions when oxygen dropped to approximately 8 percent and the carbon dioxide rose to 5 percent in the lower horizons. Although this soil was found in the river bottom, it drained very rapidly, even after complete submersion. The large amount of organic matter and the good crumb structure resulted in a soil in which approximately 50 percent of the soil volume within the 5-foot profile was pore space. Since 10 percent of the total soil volume was non-capillary pore space very good aeration resulted (Fig. 2).

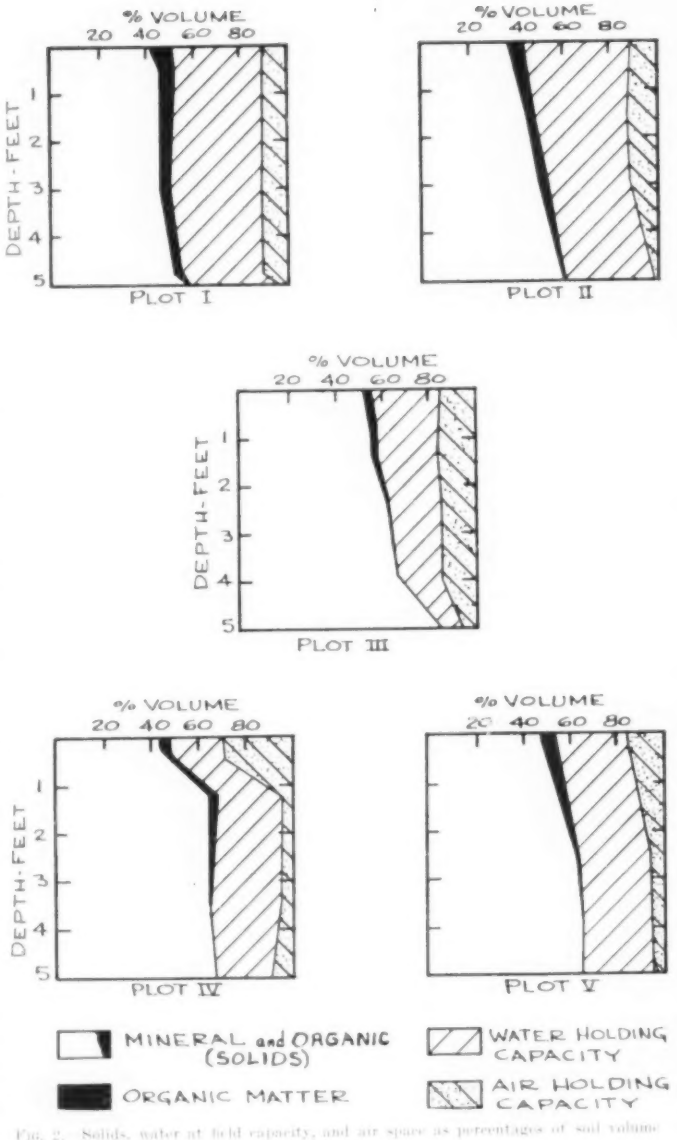

Fig. 2. Solids, water at field capacity, and air space as percentages of soil volume for five soils.

The soil of Plot III was the best aerated of all the soils studied, and was the only area where aeration was comparable to that of Plot I (Fig. 2). In the more sandy plantation soil the organic matter content was very low, none the less the highest overall percentage of noncapillary pores was found here, due, no doubt, to the great quanti-

ty (55 to 88 percent) of soil particles .05 to 1.0 mm in diameter. Being so porous and located on a hill, this soil was excessively drained and at no time did the ground water level rise to within 5 feet of the surface. Throughout most of the year the oxygen content remained between 19 and 20 percent, dropping to 18 percent only once during exceptionally heavy June rains. The carbon dioxide content remained below 1 percent during most of the year, a maximum value of 2.5 percent was recorded at the 3-foot level in mid-June. This area seemed too dry and perhaps too infertile for good growth of catalpa but adjacent white and red pines on the same soil are growing very well (Fig. 1).

Although the cottonwood type of Plot II is found on a bottomland, as is Plot I, and the soil had a high content of organic matter and an exceptionally large total pore volume (Fig. 2), it was the most striking example of poor soil aeration found in this study (Fig. 3). Since the plot is less than 10 feet above the mean low water level of the Des Moines River, internal flooding of the soil occurred throughout most of the year. As the year of 1947 was one of extreme rainfall in Iowa, Plot II was completely submerged for more than 6 weeks. Such prolonged flooding is probably uncommon but the nature of the soil profile indicates yearly flooding is to be expected. The filling of pore spaces with water, inhibiting air circulation and removal of respiration products, accounted for much of the anaerobic condition of the soil. A second contributing factor was that much of the organic matter present was only partly decomposed. Under warm, moist conditions the activity of microorganisms probably was vastly accelerated and their respiratory products added to those of the roots. Plot II had no true evolutionary profile as the horizons were merely layers of flood deposits. Some of these strata were very fine impenetrable silt while others were compressed sand and clay. It was these compact, plastic horizons that probably were barriers to air-soil interflow of oxygen and carbon dioxide resulting in the accumulation of carbon dioxide. These extremely anaerobic conditions existed for a considerable part of the growing season and would seem to be limiting to all plant species having no tolerance of high carbon dioxide and low oxygen. The maximum carbon dioxide value recorded was 15.8 percent at the 3-foot level; the minimum oxygen content was less than 2 percent. The cottonwood, willow, and silver maple found here were making good to excellent growth.

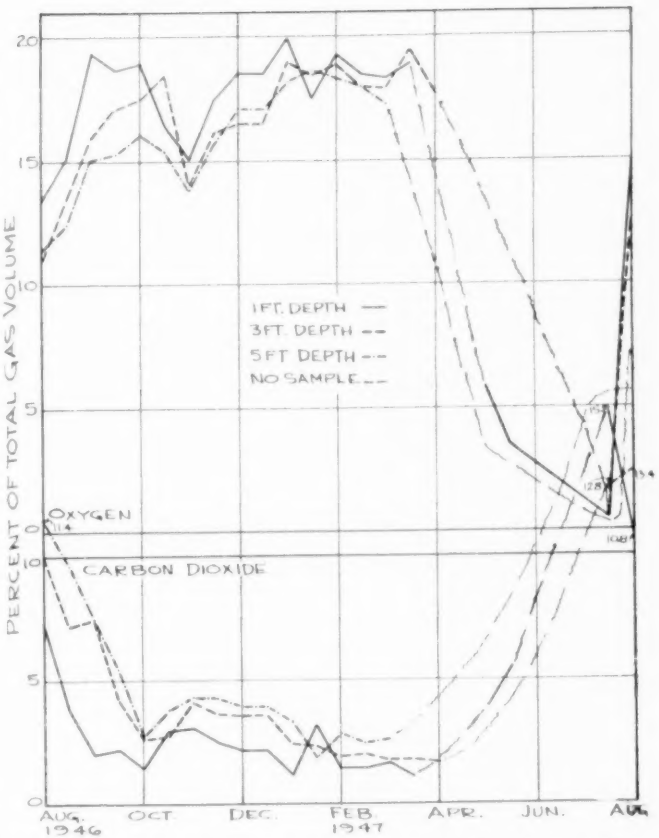

FIG. 3.—Seasonal variation of oxygen and carbon dioxide at three depths in alluvial bottomland of Plot II.

Plots IV and V were markedly similar in all respects—composition, physical soil properties, soil aeration and root concentration, and distribution. They were better aerated than Plot II but more poorly aerated than Plots I and III. Both soils had fine-textured, compact, well-developed B horizons which probably reduced soil air circulation and allowed relatively high concentrations of carbon dioxide to build up. Plot V (Fig. 4) with the more compact A horizon yielded consistently higher carbon dioxide analyses than Plot IV which was ungrazed.

After a series of heavy rains the two soils were saturated with water and the oxygen content of Plot V reached a low of 1.6 percent at the 5-foot depth with a carbon dioxide content of 3.8 percent. On Plot IV during this same period the earliest available analysis

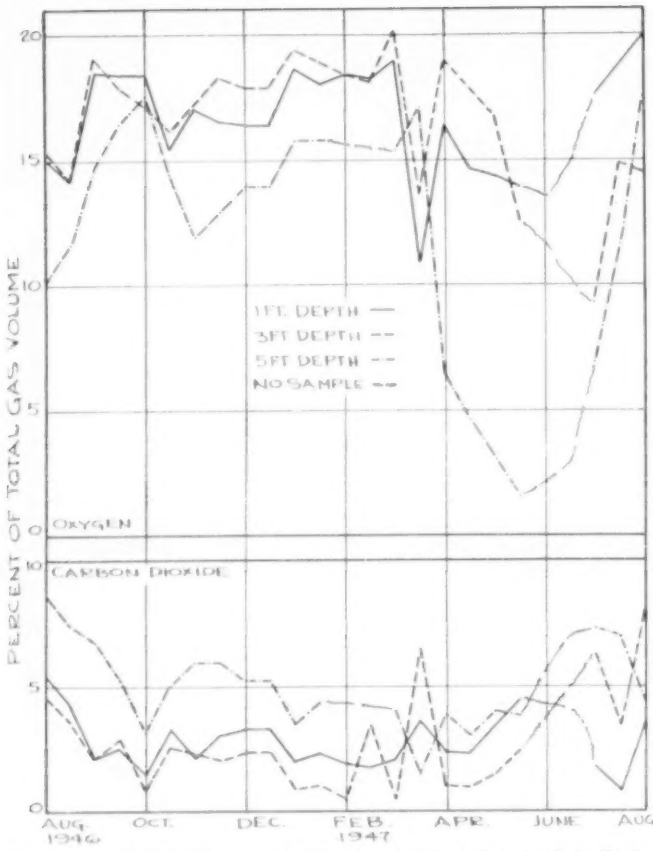

FIG. 4.—Seasonal variation of oxygen and carbon dioxide at three depths in Hayden silt loam, Plot V.

showed an oxygen content of 4 percent with a carbon dioxide content of 8 percent. During this period of exceedingly poor aeration analysis for hydrocarbons was made. A particularly outstanding sample of July 28, 1947, from Plot V showed 7 percent carbon dioxide, 11.4 percent oxygen and 3.1 percent hydrocarbons, probably methane. Over a 2-week period the hydrocarbons disappeared completely and the oxygen and carbon dioxide content returned to normal. No gas samples were obtained from Plot IV during this rainy period because of the high water table resulting from the flat topography and impervious B horizon, but it is probable that the same or poorer aeration existed. The levels of carbon dioxide and oxygen existing in these soils during the spring and early summer may well be important factors in curtailing root growth and activity, and volume increment in oak-hickory types in the prairie states.

Summary

Soil porosity, content of oxygen and carbon dioxide, root distribution and some related soil properties were studied in relation to forest composition on five soil types in central Iowa. The plots studied were characterized by soils and forest cover ranging from coarse-textured glacial materials supporting excellent growth of pine, through fine-textured glacial materials with oak and hickory to both well-drained and poorly drained alluvial bottomlands supporting black walnut, hackberry, elm, and oaks; and cottonwood, willow, and soft maple, respectively.

The soils with the greatest air-holding capacity (noncapillary pores) had higher oxygen and lower carbon dioxide content (were better aerated) throughout the year. Aeration became poorer with depth and with increasing soil moisture, and both air and water holding capacity were related to the amount of organic matter in the soils and the percentage of the larger soil particles. As the oxygen content of the soil decreased the carbon dioxide content increased. The lower the oxygen content, the further the sum of oxygen and carbon dioxide was below the 20.7 percent which characterizes the normal atmosphere. During one period of poor aeration the soil gas was shown to contain hydrocarbons (probably methane); the maximum amount measured was 3.1 percent. Minimum oxygen and maximum carbon dioxide levels recorded were 1.6 and 15.8 percent, respectively; both occurred in the cottonwood and willow type. There were prolonged periods extending through parts of April, May, June, and July when the soils, particularly at the 3- and 5-foot levels, were waterlogged and no gas samples were obtained. Maximum carbon dioxide and minimum oxygen readings were obtained following periods of waterlogging.

The concentration of tree roots decreased with increasing soil depth and root penetration appeared adversely affected by soil compaction and low air space. One thin, greasy, clay layer on alluvial bottomland was almost devoid of roots in contrast to good rooting in layers both below and above.

The soil of Plot I on which black walnut predominated was loose, deep, well drained, and well aerated, and contained no layers restricting drainage or aeration. The lowest oxygen content recorded was 7.8 percent; the highest carbon dioxide content 3.8 percent. The general area of Plot III, sup-

porting excellent growth of white and red pines but poor growth of catalpa, was well to excessively drained but lowest in water holding capacity and fertility. The lowest oxygen content recorded was 17.6 percent and the highest carbon dioxide content 2.7 percent. Plot II, supporting cottonwood and associates, was flooded periodically; the soil was made up of thin layers of alluvium varying from coarse sand to very fine clay and contained much organic matter. Poor aeration was prolonged and resulted primarily from flooding and high water table. The minimum oxygen content measured was 1.6 percent; the maximum carbon dioxide content was 15.8 percent. Both Plots IV and V, supporting white oak, black oak, and hickory had soils developed from fine-textured glacial till. The B horizons were thick, fine-textured, and compact and aeration was restricted. Maximum carbon dioxide and minimum oxygen levels were 10.1 and 1.6 percent, respectively. Compaction of the soil on Plot V by grazing and the development of a claypan on Plot IV both appeared to contribute to poor aeration and to long periods of internal waterlogging. Although the often-flooded bottomland of Plot II and the upland soil of Plot V seem completely dissimilar in composition and development there is a striking similarity in the poor sub-surface ventilation of the two soils.

The gas samples collected probably contained more oxygen and less carbon dioxide than gas trapped in the small soil pores which are not readily sampled by the technique used in this investigation. Nevertheless, the data obtained show soil oxygen and carbon dioxide contents that are beyond the levels at which physiological functions are thought to be restricted; they are probably important therefore in affecting forest composition and growth.

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Estimating Defect in Mature and Overmature Stands of Three Rocky Mountain Conifers

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Decay and other defects in trees constitute a perplexing problem in the determination of merchantable timber volume. Inaccuracy in net volume estimation is perhaps the greatest disadvantage to the practice of selling stumpage. As a contribution toward efficient cruising and net volume determination, this article presents a method of estimating cull volume in the standing tree. It describes the important defect indicators for lodgepole pine, Engelmann spruce, and alpine fir in the Central Rocky Mountain region; it outlines procedures to be followed in the estimation of defect; and concludes by showing the accuracy attained in actual field trials.

TIMBER is customarily purchased or sold on the basis of *net* volume. This is standard practice and is universally accepted in the timber industry. When trees are felled and cut into logs the scaler can readily observe and measure defects and then make the proper deduction from gross scale to obtain net scale. The determination of defect in standing trees is, however, a much more complex problem.

Good planning of logging and milling operations depends a great deal on reasonably accurate estimate of net timber volume available for cutting. Estimates of gross volume will often serve this purpose where thrifty, young, second-growth stands are involved. But this is seldom true for virgin stands of mature to overmature timber where the cull may run from 5 to 40 percent. Purchasers of stumpage usually desire to make their transactions on the basis of net volume. When the selection or other systems of partial cutting are employed, the timber marker too is concerned with the presence of defect, for his main objective is to leave a healthy reserved stand for future growth.[1] It is apparent then that much depends on the ability to detect and to estimate the defect in standing trees.

At the present time there is a strong trend toward the sale of timber by tree measurement rather than by log scale, but the success of the tree measurement method depends upon two things; first, a satisfactory estimate of gross volume; second, an accurate estimate of cull material. In discussing sample tree measurement procedure, Lexen (6) points out repeatedly that the efficiency of sampling is increased and that the number of trees that need be scaled in the woods to determine *net* volume is reduced by omitting the cull trees from the computation of net volume; and, by deducting all the detectable defect from the remaining trees. Rules are given by Boyce (2, 3) for estimating the volume of decay in Douglas-fir in Oregon and Washington, and he points out that it is possible to do so with considerable accuracy.

Because of the urgent need to reduce the cost of selling timber, a study was started on the Fraser Experimental Forest in Colorado in 1944 to assist timbermen in judging the amount of defect in standing trees. Additional data were taken and the field checks of the results were made during 1945 and 1946. Three species, lodgepole pine, Engelmann spruce, and alpine fir, were studied. This paper is primarily concerned with estimating defect in these species.

Stand Description

Most of the data were obtained from a stand of timber in an east-west drainage. The topography was rather steep. Elevations ranged from 9,100 to 10,000 feet. On the south slope the stand was 95 percent or more lodgepole pine by volume. The composition on the north slope by volume was 57 percent, 40 percent, and 3 percent for spruce, pine, and fir respectively. Other than for the absence of fire damage, this stand was considered typical of mature stands of the lodgepole pine type and of the mixed spruce-pine type. The average age of merchantable trees was about 225 years, ranging from 105 to 260 years. As this drainage had been particularly free from fire since the origin of the stand, additional data were obtained from mature, fire swept stands in other localities on the Arapaho National Forest, Colorado.

One point which no doubt had an important influence on the outcome of the study was the fact that only mature to overmature stands were examined. No truly even-aged, immature to mature stands were included in the study. All trees in this age class that were examined, occurred as scattered individuals in mature to overmature stands. Restricting the scope of the study in this manner did not detract from its value because present harvesting of lodgepole pine and spruce is largely limited to old growth. Moreover, young, thrifty, immature stands are relatively free from decay.

Field Data

In all, 1,299 trees were classified prior to cutting as to possible defect indicators. This included the following items; vigor class, clear length, dead branch stubs, size and condition of branches in the lower crown, position and condition of forks, dead tops, spike-tops, mechanical scars, fire scars, porcupine injury, cankers, Peridermium galls, top injuries, sporophores of wood-rotting fungi, swollen knots, lightning scars, frost cheeks, root exposure and injury, sound of tree when struck with axe or hammer, species and amount of rot and weevil in increment core taken from tree trunk, worm holes, woodpecker's holes, and carpenter ant attacks. Trees were felled, bucked

[1] Observations in old selection cuttings revealed that a considerable portion of the wind-broken and wind-thrown trees contained detectable decay which made them poor risks and which predisposed them to destructive fire.

into logs, and scaled, and a record of defect deductions made according to cause.[2] These data were analyzed to determine the relationship between visible external indicators and defect. At the time of logging numerous specimens of wood decay were collected for identification of the causal fungus.[3] In many cases identifications had to be made from cultures because sporophores were not present.

Causes of Defect

A tally of the total defect deductions, by causes, for the entire 1,229 trees shows the importance of the various causes of defect (Table 1). These data suggest the factors that need to be examined in the process of estimating defect in standing trees.

The data in Table 1 show that wood decay is by far the most important cause of defect, followed by crook and sweep. All other causes amounted to only 4 percent of the total. However, if a reasonably good job of estimating defect in standing trees is to be done, the estimator must know the more important wood-rotting fungi, how to identify them from external indicators and increment cores, and be skilled in the use of the standard rules for defect deductions.

Although the data in Table 1 represent the distribution of defect volume by causes for one timber stand, it does not necessarily follow that the defect volume in another timber stand will follow exactly the same pattern. For example, a stand that has been severely damaged by fire will have, very likely, a much higher proportion of cull due to catface and possibly to associated butt rott and worm holes than found in this study. All the fungi listed in Table 1 were not found infecting all three species. Moreover, those fungi found infecting two or more species were not always of equal importance as a cause of defect.

TABLE 1.—PROPORTION OF DEFECT VOLUME BY CAUSES IN ENGELMANN SPRUCE, LODGEPOLE PINE, AND ALPINE FIR

Nature of defect	Percentage of total defect volume	
Root and Butt Rots		
Polyporus circinatus (False velvet top fungus)	8.0	
Coniophora cerebella	5.0	
Armillaria mellea (shoe string root rot)	1.0	
Polyporus ossecus	trace	
White Trunk Rots		
Fomes pini (red ring rot)	64.0	
Fomes nigrolimitatus	trace	
Brown Trunk Rots		
Peniophora luna	4.5	
Stereum sanguinolentum	2.0	
Fomes pinicola	2.0	
Trametes serialis	0.5	
Fomes laricis	trace	
Total all wood decay		87
Crook and sweep	9.0	
Fork or crotch	1.0	
Fire scar (catface)	1.0	
Canker	1.0	
All other causes (lightning, frost crack, check and split, mechanical injury, pitch seam, wind shake, etc.)	1.0	
Total all causes other than decay		13
Total		100

Defect Indicators

Most of the cull is associated with a relatively few defect indicators. In order of importance they are: conks or fruiting bodies, swollen knots, sound produced when tree is pounded, decay showing on increment core, crook and sweep, fire scars, forks, cankers, frayed branch stubs, lightning scars, frost and wind cracks, and top injuries. Although the other factors previously mentioned as possible defect indicators are not closely related to defect volume, it is considered unwise to disregard them completely. In certain cases they serve to cast suspicion on a tree and suggest the need for a more detailed examination.

Vigor class[4] in itself is not indicative of defect, but in mature stands a strong relationship was indicated. In vigor classes A and B, 22.7 percent of the trees contained decay, compared with 30.2 percent of Class C and 49.0 percent of Class D. Trees with abnormally short needles or with thin or fading crowns sometimes indicate decay of the stem or root system which has progressed to such an extent that the physiological functioning of the tree is impaired.

Aside from frayed branch stubs, clear length and size and condition of the branches in the lower crown are not related to defect. Dead-tops and spike-tops, like sickly and fading crowns, sometimes indicate advanced decay of the stem or root system.[5] Pitchy spikes are seldom associated with decay. Top rot is occasionally associated with very old and ragged spike-tops. In general, however, dead-tops and spike-tops are not directly related to defect because they usually result from other than rot-causing agencies.

[2] The scaling practice followed the procedure outlined in the National Forest Scaling Handbook. U. S. Dept. Agric., Forest Service, 1949.

[3] Grateful acknowledgement is made of the assistance of Ross W. Davidson and James L. Mielke, of the Bureau of Plant Industry, Soils, and Agricultural Engineering, who made field examinations, annual decay collections, and who identified the wood decay specimens collected by the author, and to Dr. Mildred K. Nobles, Division of Botany and Plant Pathology, Dominion Department of Agriculture, Canada, and to Dr. H. S. Jackson, University of Toronto, for valuable assistance given in the identification of some fungi and confirmation of other identifications.

[4] The lodgepole pine tree classification (8) was applied to all species, although the adaptation of this system to Engelmann spruce and alpine fir has not been published.

[5] Dead-tops, as distinguished from spike-tops, are living trees with dead tops which still retain limbs and twigs. Spike-tops are living trees with a dead top from which practically all branches have fallen. This implies that the tip has been dead longer on a spike-top than on a dead-top.

TABLE 2.—CHARACTERISTICS OF WOOD DECAY CAUSED BY SEVERAL FUNGI PRODUCING DEFECT IN LODGEPOLE PINE, ENGELMANN SPRUCE, AND ALPINE FIR

Fungus	Decay		Location	Aver. length of decay	Species attacked		
	Early stage	Late stage			Pine	Spruce	Fir
				Feet			
Root and Butt Rots							
P. circinatus	Reddish to purplish	Wood straw-colored; elliptical pockets merge lengthwise	Butt	8	x	x	Rare
C. cirrhella	Yellow to brown	Charcoal like cubes, blackish borders	Butt	4	x	x	Occasional
A. mellea	Pale yellow to brownish	Light yellow to olive yellow; spongy	Butt	2	x	x	Rare
P. osseus	Light brown	Light brown; shrinkage cracks frosted	Butt	2	x	x	—
White Trunk Rots							
F. pini	Pink zone, reddish brown	Red brown with white elliptical pockets	Butt, trunk, top	Extensive	x	x	x
F. nigrolimitatus	Pale brown elliptical pockets	Large rectangular white pockets	Butt	8	—	x	—
Brown Trunk Rots							
P. luna	Pale reddish brown	Reddish brown to dark brown	Trunk	4	x	x	—
S. sanguinolentum	Pink tinge to light brown, wood firm	Light to dark brown, friable	Butt, trunk, top	Extensive in fir	—	x	x
F. pinicola	Faint yellow to brown stain	Yellow brown, cubical, white mycelial mats in shrinkage cracks	Butt & trunk injuries	Variable	x	x	—
T. scrialis	Color faint to lacking	Brown charcoal like cubes	Top, trunk, basal	Variable to extensive	x	x	—
F. laricis	Pale brown difficult to recognize	Yellow brown irregular cubes Bitter white felts in shrinkage cracks	Trunk	Extensive	x	—	—

Defect is seldom associated with mechanical scars on lodgepole pine. All pines develop a protective coating of pitch. On very old scars which have lost their protective outside coating, the surface wood is usually impregnated with pitch. On the other hand, very old mechanical scars on Engelmann spruce and alpine fir are frequently associated with decay. Shallow injuries caused by one tree rubbing against another seldom are associated with defect. But deep-seated, long-standing injuries resulting from one tree growing against and partially enveloping the limb of another are frequently the foci of infection for heart rot.

Partial to nearly complete girdling of trees by porcupines and squirrels is very common in lodgepole pine stands. Porcupine injury commonly occurs near the base of the tree, while squirrel damage is usually confined to the upper trunk or tree top. Pitchy spike-tops are usually caused by squirrels periodically gnawing the infected bark from the edge of active Peridermium infections until the trunk is finally girdled. Although this type of injury is common on pine, it is seldom associated with decay. Such injuries occur less frequently on spruce and fir than on pine. On the other hand, it is common for any one of several butt rots to be associated with old root or butt injuries on either spruce or fir.

Trees growing on hillsides or adjacent to roads and trails occasionally have portions of their root systems exposed. These roots are frequently injured by fire, sunscald, treading, skidding, falling or rolling objects, and moving vehicles. Although the frequency of root injury was very low, 4.3 percent of all trees having one or more large roots exposed and injured were infected with decay which presumably originated in the roots.

Although "wetwood" is not considered a deductible defect in log scaling, it does cause seasoning troubles and results in considerable degrade in lumber. Wetwood occurred on increment cores in 2.3 percent of the lodgepole pine and alpine fir trees. No relationship could be established between the occurrence of wetwood and decay other than in alpine fir where wetwood is frequently associated with frost cracks and wind shake.

Worm holes, woodpecker holes, and carpenter ant attacks were infrequent except on fire-scarred trees. Where these did occur, however, the trees were found to be severely decayed and to have an abundance of other indicators of rot.

Description of Rots

Several fungi[6] caused decay in the material studied. For convenience of description, they are grouped according to the part of the tree most generally affected. Within each group they are listed according to importance. The characteristics of wood decayed by fungi causing defect in the three species studied are given in Table 2.

Root and Butt Rots

Altogether root and butt rots caused 14 percent of the total defect. Several types of butt rot were found to occur in all three tree species. Red rood rot, described by Hubert (4), caused by *Polyporus circinatus* Fr. (Fig. 1) was responsible for 8 percent of the total defect volume or slightly more than one-half of the defect caused by butt rots. Brown charcoal-like rots caused chiefly by *Coniophora cerebella* Pers. (Fig. 2) contributed 5 percent of the total defect volume or slightly more than one-third of the defect caused by butt rots. A yellowish butt rot caused by *Armillaria mellea* (Vahl.) Quel. was found occasionally and a light brown butt rot caused by *Polyporus osseus* Kalb. was rare.

White Trunk Rots

Two white trunk rots were encountered in this study. These are *Fomes nigrolimitatus* (Rom.) Egel., which occurred but once, and *Fomes pini* (Thore) Llyd., the most important and widespread heartrot fungus in the lodgepole pine region. This species caused nearly two-thirds of the defect in the stands studied. Skill in recognizing the presence of this fungus in a standing tree is therefore of utmost importance. Because it can be detected by reliable external indicators, woodsmen should become thoroughly acquainted with it.

Baxter (1), Boyce (2), Hubert (5), Wier and Hubert (9), and Shope (7) studied and reported extensively on the decay caused by this fungus. In addition to the perennial conks, the outstanding external indicator of the presence of decay by this fungus is the swollen knot on lodgepole pine and the sunken knot on Engelmann spruce and alpine fir. Because of their importance as a defect indicator, special attention is directed to Figures 3, 4, and 5.

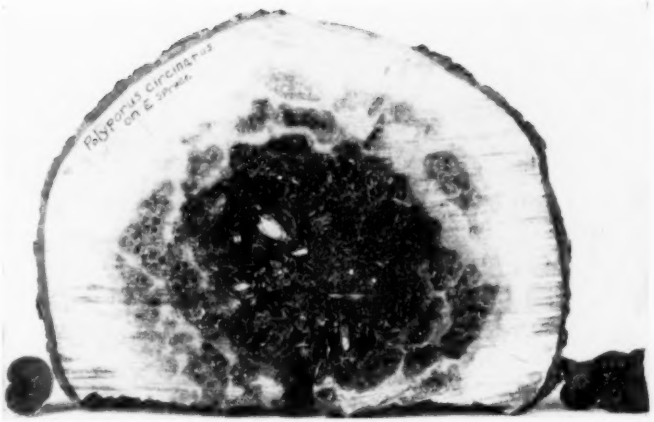

FIG. 1.—Red root rot in Engelmann spruce caused by *P. circinatus*. The woody, annual fruiting bodies of this fungus usually arise from the roots of infected trees during the wet summer period.

FIG. 2.—*Coniophora cerebella* causes a dark brown charcoal-like butt rot that predisposes trees to windfall. Decayed trees are found by pounding the butt with axe or hammer and observing for checks and ruptures in the trunk.

Brown Trunk Rots

Brown trunk rots were found to cause 9 percent of the total amount of cull. In the absence of sporophores, the different brown trunk rots usually cannot be distinguished by the appearance of the decays on the ends of cut logs or from increment cores. Several of these rots appeared to be selective in their host because they were not found on more than one species. *Peniophora luna* Rom.,[7] a fungus not previously reported in Colorado, caused 5.4 percent of the total cull. It was found associated with frayed branch stubs and causing a pocket rot in lodgepole pine and Englemann spruce (Fig. 6). *Stereum sanguinolentum* Alber. and Schw. was found in both Engelmann spruce and alpine fir. Although this fungus caused but 2 percent of the total cull volume in this study, it is, nevertheless, an important destroyer of alpine fir. *Fomes pinicola* (SW.) CKe., a common scavenger on dead and down timber, was found attacking both lodgepole pine and Engelmann spruce, and caused 2 percent of the total cull volume. *Trametes serialis* Fr. was found attacking both lodgepole pine and Engelmann spruce, but caused only 0.5 percent of the total cull. Although

[6] Complete descriptions and information concerning the fungi listed and their decay characteristics may be obtained by referring to the literature cited.

[7] Identified by Dr. H. S. Jackson, University of Toronto, Canada, from cultures developed by Ross W. Davidson and James L. Mielke.

FIG. 3.—Swollen knots caused by *Fomes pini* on mature lodgepole pine trees are a certain indication of cull trees.

the occurrence of this fungus was rare, the decay was extensive. *Fomes laricis* (Jack.) Murr. occurred but once, on a lodgepole pine, which was a complete cull.

Procedure For Estimating Defect

Most of the cull volume is associated with few defect indicators (Table 3). To estimate the cull in a standing tree, it should be examined closely for the following indicators, listed in order of importance: conks, swollen knots, sound obtained by pounding the tree, rot showing on increment core, crook and sweep, fire scars, cankers, forks, frayed branch stubs, lightning scars, frost and wind cracks, top injuries consisting of tops broken out, one fork broken out, bayonet tops or secondary leaders, and spike-tops. Butt rots frequently weaken the tree to such extent that the movement of the trunk by wind causes it to rupture. Splits and cracks at the base call for a detailed examination.

Cull trees.—Mature trees with either conks or swollen knots of *F. pini* should be considered complete culls. The exception to this rule is an occasional butt or top log that will be partially sound. All mature trees bearing either conks or swollen knots were found to be 80 percent or more defective. Such trees do not meet merchantability standards which require that at least 25 percent of the volume be merchantable. Trees bearing conks of the red belt fungus *F. pinicola* and of the quinine fungus *F. laricis* should also be considered culls.

Sounding.—Sound each tree by pounding with an axe or hammer. Trees should be sounded as high as can be reached, as well as at the base. Probe with an increment borer at the points where rot is indicated to obtain a sample of the rot for identification. Frequently one or more species of rot may be present at the base or lower trunk of a tree. Trees containing decay cannot always be definitely identified by sounding. When decay is in the incipient stage the sound produced is similar to that obtained from an undecayed tree. This presents no great practical problem, however, because scaling should be governed by the principle that deduction for defect is made only where the defect causes a reduction in the sound material. However, when the decay has advanced to the stage where the cellular structure is breaking down, the tree will emit a deeper, drum-like note. Doubtful trees—those that produce a sound when struck that does not clearly indicate whether or not they are decayed—should be probed with an increment borer to determine the presence of decay.

In sounding alpine fir, slice off a piece of bark and pound directly on the wood, because the spongy bark tends to absorb the blow and muffle the sound. While small undecayed Engelmann spruce trees give out a sharp ringing sound when struck, large undecayed spruce emit a deeper note, which to the inexperienced ear, might be misleading. The reason for this, it is presumed, is that a larger proportion of heartwood to sapwood in large trees gives a greater resonance to the sound. With a keen ear and a little practice one can soon learn to detect the difference in sound obtained from a large undecayed spruce tree from that obtained from a defective one. Trees containing frost or wind cracks do not emit a normal sound when pounded even though no decay is present.

Rot showing on increment core.—Experts cannot always identify a rot from an increment core sample, much less the novice. However, the increment core sample is useful to determine whether the rot is brown or white; and therefore, the distinction most generally will be between butt rots and trunk rots. Differentiation between butt rots and trunk rots is important because of the amount of defect deductions that should be made for each.

If the tree is too large to be bored through completely, it should be bored from two sides. Even though rot is present, it does not always show in the core be-

cause of the position or distribution of the rot column. However, if the rot is extensive it will usually be evident.

If the rot is *Polyporus circinatus*, cull the butt log.

If the rot is *Coniophora cerebella*, cull 4 feet of the butt log, or reduce the scale of the butt log by one-quarter.

If the rot is *Armillaria mellea* or *Polyporus osseus*, cull 2 feet of the butt log, or one-eighth the volume of the butt log.

If the rot is *Fomes pinicola*, and the rot column does not exceed one-fourth of the heartwood diameter, cull the butt 2 feet; if the rot column is one-quarter to one-half the heartwood diameter, cull 4 feet of butt log; if the rot column is one-half to three-quarters of the heartwood diameter, cull one-half the volume of the butt log; if the rot column is greater than three-fourths of heartwood diameter, but no conks are present, cull the butt 24 feet; if conks are present, cull the entire tree.

When the rot is *Fomes pini*, examine more closely for conks or swollen knots. If conks or swollen knots are present on a mature tree, cull it completely. If the tree is immature (under 160 years old) cull one-half the volume of the log infected. If conks or swollen knots are absent, deduct as follows: Rot column does not exceed one-fourth of the heartwood diameter, cull the butt 8 feet; rot column more than one-fourth but not more than one-half of heartwood diameter, cull the 16-foot butt log; rot column more than one-half but not more than three-fourths of heartwood diameter, cull butt log and one-half of second log; rot column greater than three-fourths of heartwood diameter, cull three-fourths of the tree volume.

If the rot is *Fomes nigrolimitatus*, cull one-half the volume of the butt log.

If the rot is *Stereum sanguinolentum*, and the rot column occupies up to one-fourth, one-half, three-fourths, or more than three-fourths of the heartwood, the respective cull deductions are: one-fourth the volume of the butt log but not less than 10 board feet; one-half the volume of the butt log but not less than 20 board feet; three-fourths the volume of the butt log; and the volume of both the first and second logs.

FIG. 4. Cross section through two swollen knots, caused by *F. pini*, top and right, showing the brown punky interior in contrast to the sound knot on the left. The entire heartwood is in the last stage of decay.

If the rot is *Trametes serialis* and the decay occupies one-fourth, one-half, or three-fourths or more of the heartwood, the respective cull deductions should be one-fourth, one-half, and all the volume of the butt log.

Crook and sweep.—Deductions for crook and sweep are made similar to those in actual scaling practice. Only in this case, instead of measuring the amount of crook or sweep, each tree is examined and an estimate made of the cull deduction that would normally be made in scaling if the tree were felled and bucked into logs.

Fire scars.—Fire scars should be viewed with suspicion. Scars of recent origin are seldom evidence of deductible rot. For such scars, make an ocular estimate of the volume lost in the butt log. Old fire scars are frequently accompanied by rot. The rot is usually a butt rot but *F. pini* is also found to occur near the upper portion of fire scars. If rot is present the preceding rules should be followed for making cull deductions for rot as well as for making allowance for the size and depth of burn.

Forks.—A distinction between sound forks and defective-appearing forks (those that were ruptured, calloused, or bleeding) proved unreliable as evidence of decay. Ruptured and calloused forks were frequently sound, whereas apparently sound forks often contained decay.

In mature trees, more than 50 percent of all forks, regardless of the position in the tree, are the

FIG. 5.—Sunken knots on Engelmann spruce caused by *F. pini*. On a mature tree they indicate a complete cull.

starting points of rots. These rots are usually caused by *F. pini*. All forks should be examined closely for conks or swollen knots, the tree sounded, and probed with an increment borer. If no rot is evident and the fork is in the merchantable part of the bole, make ocular estimate for crotch and then double the normal deduction for crotch defect.

Cankers.—The majority of lodgepole pine cankers are caused by *Peridermium* sp., but the causal organism of spruce canker was not determined.

Deductions for canker are made in a similar manner to that for crook and sweep. An ocular estimate is made of the defect deduction to be made for each canker. Usually this does not exceed 10 board feet per canker. No deduction is made for canker deformities that lie outside the scaling cylinder.

Branch stubs.—Old frayed branch stubs that are 1.5 inches or more in diameter at the tree bole are frequently associated with pocket rot, *P. luna*. Cull 10 board feet for each tree having 1 to 5 such stubs, 20 board feet for each tree having 6 to 10 such stubs and 30 board feet for each tree having 11 or more such stubs.

Lightning scars.—Only a few lightning scars were observed. With the exception of very old scars on spruce, decay was not associated with lightning scars. Here the decay had not progressed far and the standard deduction for the scar alone was sufficient to take care of any reduction in volume due to decay.

Deductions for lightning scars are handled as in standard scaling practice. The number of logs affected is noted and an estimate made of the proper volume deduction for each log according to the depth and amount of spiraling.

Frost and wind cracks.—This type of defect should be examined closely for rot. Trees containing cracks do not sound normal when pounded even though rot is not present. If rot is present, follow the rules already given for making rot deductions. If rot is absent, follow the usual scaling practice but estimate the amount of defect to be deducted for each log. This deduction usually varied from one-eighth, one-fourth, one-third, or one-half of the log volume depending upon the depth and amount of spiraling.

Top injuries.—Examine trees carefully for rot because top injuries are a common point of infection, and frequently tops break out because the are weakened by decay. Examine for rot, portions of broken out tops or broken out forks, or large limbs that have fallen to the ground. If rot is present at the break but not in evidence at the base of the tree, cull the first log below the break. If the break is recent and no rot is in evidence make no deduction, but if it is an old break and rot is absent, cull one-half of top log. Trees with bayonet tops or secondary leaders should be viewed with suspicion. Such injuries are commonly associated with decay caused by *F. pini*, *S. Sanguinolentum* or *T. serialis*. Examine the rest of the tree closely for rot. If rot is not in evidence, that is, if no conks or swollen knots are present, make ocular estimate for crook or crotch and

FIG. 6.—Old, frayed branch stubs that are one and one-half inches or larger in diameter at the bole are the best indicators that pocket rot, caused by *Fomophora luna*, may be present.

TABLE 3.—EXTERNAL INDICATORS OF DECAY IN TREES

Fungus	Form	Fruit bodies: On ground near roots	Fruit bodies: On trunk	Fruit bodies: On slash or down trees	Fruit bodies: Under dead limbs or on slash	Swollen knots	Splits or cracks	Soundings	Injuries	Resin flow	Fading foliage	Frayed branch stubs
Root and Butt Rots												
P. circinatus	Woody annual	x					x	x	Basal			
C. cerebella	Skin-like annual			x			x	x	Basal			
A. mellea	Gilled mushroom	x	At Base					x	Basal	x	x	
P. ossaus	Grey, overlapping annual	x	At Base					x	Basal			
White Trunk Rots												
F. pini	Perennial bracket		x	x	Under limbs	x		x	Any place			
F. nigrolimitatus	Perennial crust		At Base	x				x	Basal			
Brown Trunk Rots												
P. luna	Crust-like annual			x					Tops, forks			x
S. sanguinolentum	Crust-like annual, bleeds red				x			x	Tops, forks, trunk, basal			
F. pinicola	Perennial bracket		Basal wounds	x				x	Basal, trunk			
F. scalaris	Crust-like shelf-like annual				x			x	Basal			
F. laricis	Hoof shaped perennial		x					x	Trunk			

double the amount of the normal deduction for this defect.

Spike-tops. — Trees with old spike-tops bear close inspection. Trees with dead tops still retaining limbs and small branches are seldom defective. Pitchy spike-tops, identified by their yellowish color, are seldom defective; other spike-tops, however, frequently indicate heartrot. If conks or swollen knots are not in evidence, sound the tree and probe with the increment borer. If butt rot is present, follow the rules given for it; if *F. pini* is present, consider that it runs through the tree to the spike and cull according to the amount of the rot in evidence in the heartwood and the length to the spike. Assume that the rot column is largest at the base of the spike and is descending the trunk. This procedure results in culling the top log and culling all or portions of the logs below, depending upon the size and stage of the rot column at the butt.

To facilitate the estimation of defect in standing trees, Table 4 gives the average distribution of tree volume by logs according to the position the log occupies in the tree.

Field Trials

Following the development of the rules for estimating defect, two field checks were made. Both of these checks gave ample evidence that if defect rules were followed carefully, accurate estimates of cull volume could be made.

In the first trial a stand of about 4,000 trees was measured and marked for cutting. The timber included all three species, but lodgepole pine predominated. As each tree was marked, its d.b.h. was measured, its height in number of logs to an 8-inch top was estimated, and lastly, an estimate was made of any defect present in the tree. Gross volumes were determined from a merchantable height volume table. The estimated net volumes were obtained by deducting the estimated defect from estimated gross volume obtained from the volume table. Every tenth tree marked was designated as a sample tree. However, the designation of sample trees was made after the estimation of number of logs and defect had been made. This procedure was followed in order to make certain that no greater care was exercised in estimating the merchantable height and defect of sample trees than was used for

TABLE 4.—AVERAGE DISTRIBUTION OF TREE VOLUME BY LOGS ACCORDING TO LOG POSITION IN THE TREE[1]

For Lodgepole pine, Engelmann spruce, and Alpine fir

Number of 16 ft. logs per tree	Position of log in the tree											
	1	1½	2	2½	3	3½	4	4½	5	5½	6
	Percentage of total tree volume											
1	100											
1½	68	32										
2	62	—	38									
2½	52	—	34	14								
3	47	—	35	—	18							
3½	43	—	32	—	19	6						
4	41	—	30	—	20	—	9					
4½	39	—	27	—	19	—	11	4				
5	34	—	27	—	20	—	13	—	6			
5½	32	—	27	—	20	—	13	—	7	1		
6	29	—	25	—	20	—	14	—	8	—	4	

[1] Based on volume in board feet, Scribner D.C. scale, with a top utilization limit of 8 inches inside bark.

non-sample trees. As a final step, all sample trees were felled, bucked, and scaled in order to get their true net volume.

In the first trial 92 percent of the total defect obtained by actual scaling was estimated by following the defect rules. This was equivalent to estimating total net volume within 2.45 percent; an error small enough to fall below the maximum acceptable limits for check scaling logs over 20 percent defective. Actually, in this case the stand was 30.6 percent defective, and 9.9 percent of all sample trees were complete culls. Of the total number of cull trees, nine out of every ten were correctly judged to be complete culls. In no case was a sound tree classified as a cull.

In the second trial a stand of 834 trees, including all three tree species but predominantly spruce, was tested following the same procedure as outlined for the first trial. The actual percentage of defect determined from the scaled sample trees, was 15.4 percent, and the estimated percentage of defect was 13.2 percent. The discrepancy between actual scaled defect and the cull volume estimated in the standing tree was only 2.2 percent. This closely approaches the Forest Service standard of 2 percent as a maximum acceptable difference between a check scale and the original scale of logs 11 to 20 percent defective.

To demonstrate further the usefulness of defect estimates in determining net volume by the sample-tree measurement method, four tests were made. These tests involved four different methods of arriving at net volume from gross estimated volume and from estimated net volume. The first three methods are applicable to actual field practice, but the fourth, to which the first three were compared, is impracticable for field use. It does, nevertheless, provide the most accurate estimate of net volume that is theoretically possible. The tests were as follows:

1. Net volume of the average tree was derived from the regression of actual scaled net volume on the estimated gross volume. Estimated gross volume was obtained from a volume table by using the estimated number of logs per tree. This method gave the largest standard error of estimate, which was to be expected since the method includes volume table errors, personal errors in estimating the number of logs per tree, and variation caused by defect.

2. Net volume of the average tree was derived from the regression of actual scaled net volume on estimated net volume. In this case, estimated net volume was obtained by correcting the estimated gross volume for any defect apparent in the standing tree. This method differs from Test 1 only in that a correction was made for estimated cull when necessary. However, in this instance the correlation and regression is considerably improved merely by the estimation of the defect content of each tree. This case represents the results which might be expected in actual field practice when good estimates of defect have been made, but when the timber estimator has only average ability in estimating the number of logs per tree.

3. Net volume of the average tree was derived from the regression of actual scaled net volume on estimated gross volume. In this instance estimated gross volume was obtained by applying the actual number of logs cut from each tree to the volume table. In this case, volume table error and variation due to defect are included in the estimate of gross volume. However, personal error in estimating the number of logs is entirely removed. This represents the best correlation and regression that could be obtained in actual field practice with an experienced timber estimator who does not make any corrections in his volume estimates for defect.

4. Net volume of the average tree was derived from the regression of actual scaled net volume on estimated gross volume of Test 3 by deducting the cull volume estimated in the standing tree. In this instance, only volume table error and the error of estimating defect in the standing tree are involved. Errors in judging the number of

TABLE 5.—STATISTICS FOR COMPARISON OF FOUR METHODS OF ESTIMATING NET VOLUMES OF TIMBER

Test	Variance of sampling error	Efficiency	Sampling error	Trees required
	Bd. ft.	*Percent*	*Bd. ft.*	*Number*
1	85.6	43.6	9.25	176
2	62.2	60.2	7.87	124
3	62.8	59.4	7.93	127
4	37.3	100.0	6.11	81

logs are removed. This case represents about the best estimate of net volume possible. Further improvement could be obtained only through greater skill in estimating defect in the standing tree and through volume table improvement.

The statistics pertinent to the four tests are given in Table 5. They show conclusively the advantage of deducting defect from the estimate of gross volume and also the value of estimating the height of each tree in logs correctly. Test 1, which represents a rather low standard of volume estimating, requires about twice the number of trees in the small sample to maintain the same standard of accuracy as is required when height estimating is perfect and a good job is done in estimating defect (Test 4).

The results of Test 2 and Test 3 emphasize the need for accurate height estimates as well as defect if reliable estimates of net volume are to be obtained from a minimum number of trees. Good defect estimating alone will not yield optimum results.

To avoid serious errors from creeping into the tree-measurement method of volume determination, it is recommended that on all important sales that at least one hundred randomly selected trees be scaled to provide a comparison of estimated net volume with actual net volume. This small sample will not only provide a correction for all the unseen factors in estimating volume, but will keep the estimator posted on how well he is doing his job. If his work tends to be inaccurate this will be detected from his small sample and, as previously shown, complete analysis of the sample will indicate whether the trouble arises from poor defect or poor height estimating, or both. When the source of error is determined, steps can then be taken to reduce it, either by increasing the small-sample size or by developing greater skill in estimating merchantable height or defect deductions.

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Epicormic Branching of Young Yellow-Poplar[1]

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IS IT SAFE to thin crowded stands of second-growth yellow-poplar, or will reserved trees degenerate? Will their stems "feather out" badly; i.e., produce numerous water sprouts which will persist to lower the unit value of future sawlogs?

Epicormic branches develop from both dormant and adventitious buds. Many branches appear to die young, however, and to be replaced by a succession of short-lived shoots. Repeated sprouting, in a given spot on a tree may leave small blemishes in the wood, or lumber may be degraded by knots if the branches survive. Even if the knots are too deep to slab off, the increase in growth and volume brought about by thinning may offset such loss. However, if sprouting and accompanying degrade should represent net loss, then thinning would be inadvisable. Thus, the question is whether thinning will bring a net gain in a final lumber return by increasing volume, or a net loss by increasing knots.

As an aid to answering this question, observations on the relation of sprouts to thinning are recorded in this paper. They represent the change that took place over a 10-year period in numbered sample trees.

Epicormic sprouts appear as a symptom of loss in physiological balance. Such unbalance is sometimes caused by extensive top breakage from ice storms and occasionally from severe smothering by grapevines. More frequently, sprouts arise when and where they are most needed to restore the loss of the lower crown suffered by crowded trees. After crowns become too short, sprouts are thus a response that tends to arrest or even reverse the process of natural pruning (see Figure 1). The reversal is probably temporary where trees remain in crowded situations, and permanent where the encroaching neighbor trees are removed. Whether or not this reaction precludes benefits from thinning timber depends on location, persistence, and relative abundance of these sprouts.

An earlier study of sprout behavior in old growth[2] showed no alarming increase in numbers of sprouts following cuttings of varying severity. On trees left uncut, bole deterioration was almost negligible; it remained to be seen

[1] Based on field observations by W. T. Doolittle and the author on the Fernow Experimental Forest, near Parsons, West Virginia.

[2] Jemison, G. M., and F. X. Schumacher. 1948. Epicormic branching in old-growth Appalachian hardwoods. Jour. Forestry 46:252-255.

Fig. 1.—Sprouts on released trees can arrest death from suppression and restore vigor and normal rates of growth. At the time of thinning, this tree had such a small crown that its death from suppression seemed almost inevitable. However, crown length after thinning increased from about 20 to 50 percent of height in 10 years (all branches below the dotted line are new), permitting a growth of 1.8 inches in diameter. The present crown is roughly 80 percent new, but two logs are still clear of persistent branches.

whether second-growth timber could do as well. Observations in West Virginia and elsewhere have revealed certain tendencies in the sprouting habit of forest-grown second-growth yellow-poplars. Trees equally crowded on all sides may sprout most on the warmest side (usually the southwest if the aspect is southerly, westerly, or level). Forest trees, however, are seldom equally crowded on all sides. Most of the sprouts occur on the open side, the side where the branches are longest. Few sprouts occur within the crown; many are located in the upper part of the clear bole. They are most abundant on intermediate and suppressed trees, but they tend to increase with the degree of release given to dominant and codominant trees.

The most recent observations reveal sprouting to a degree less serious than many foresters have expected. Although the longevity of individual sprouts has not been studied, the net changes in numbers have been observed over a 10-year period. Repeat counts were made on uninjured dominant or codominant trees thinned 10 years ago.

Among these trees, the light sprouters outnumbered the heavy by 3 to 1. A sample of 25 trees in each class revealed some interesting changes in the average number of sprouts during the decade following thinning. Comparing heavy and light sprouters, the so-called heavy sprouters had nearly twice as many sprouts in 1939 and nearly three times as many in 1949, suggesting that trees which are naturally bad in this respect tend to become progressively worse (see Table 1). In both classes the bole above 33 feet showed a mean increase in number of sprouts, heavy sprouters gaining over three times as many sprouts as the light sprouters. Butt sections, however, showed a significant tendency to clean themselves. In the light sprout class, the lower two logs, which in 1939 averaged 7 sprouts per tree, had lost all but one. Heavy sprouters indicate a similar significant relationship, but the extent

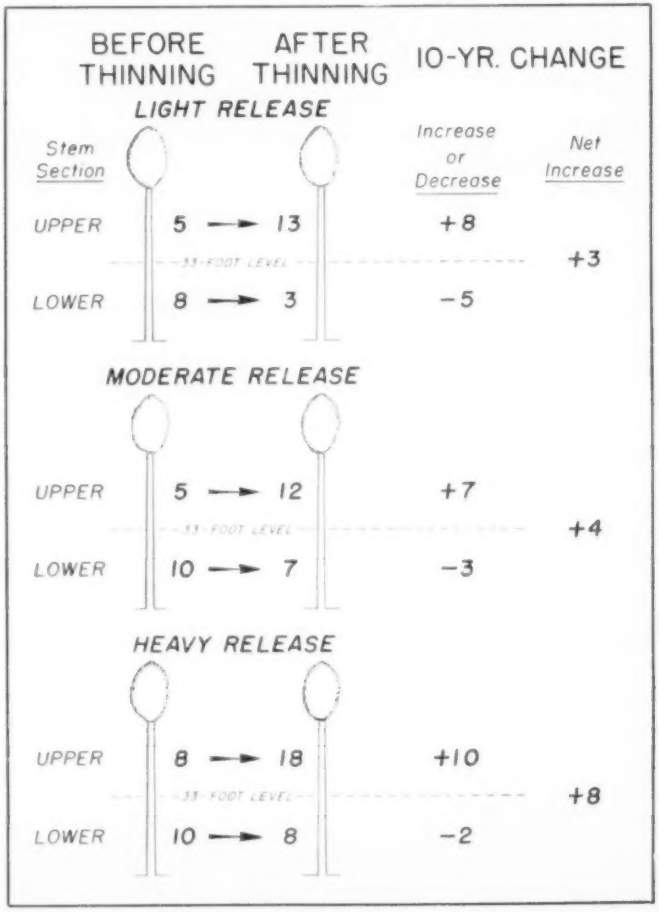

Fig. 2.—Effect of thinning on numbers of epicormic branches at high and low levels. This is a thumbnail sketch of the highlights of Table 2, obtained by rounding off decimal parts of data.

TABLE 1.—EVIDENCE OF INHERENT SUSCEPTIBILITY TO SPROUTING AT TWO LEVELS[1]

	Below 33 feet	Above 33 feet	Entire bole
	Sprouts per tree		
Light sprout class			
1939	7.0	3.5	10.5
Change	—5.7	+4.0	—1.7
1949	1.3	7.5	8.8
Heavy sprout class			
1939	11.3	7.9	19.3
Change	—1.2	+13.5	12.3
1949	10.1	21.4	31.6

[1]The low level, "below 33 feet," covers the first two standard log lengths plus stump. "Above 33 feet" covers the remaining portion of the clear stem. Sprouts within the crown were not counted.

of cleaning is much less and is significantly correlated with initial sprouting. Individual trees which bore more than 10 initial sprouts tended to reduce the number; those with less than 10 showed a slight increase.

Basal area per acre adjacent to these trees before cutting varied between 70 and 130 square feet, averaging about 105. From one-third to four-fifths of the basal area of stands was cut in 1939 in thinning and removal of hold-over old-growth trees.

Since each tree on which the sprouts were counted was differently situated, degree of release was estimated tree by tree from adjacent stumps and classified as in Table 2.

The highlights of these average results, including both living and dead sprouts, are shown in Figure 2, with decimals rounded to the nearest whole sprout. There was a net increase in sprouts for all released trees, the heavily released trees gaining twice as many sprouts as those moderately released[2]. But note the plus and minus signs and the location of these increases. In each instance sprouts on the butt section actually decreased while those above increased. This upward shift in sprout location corresponds with the elevation of the thinner-barked section of the bole as the trees grow in height. It is is a change to be expected as trees grow older. The tendency leaves the lower bole clear for the production of high-grade lumber. The silvical significance here is that the butt log clears more rapidly following light than heavy release. On the average the first two log-lengths lost about two sprouts in 10 years after heavy release and lost twice as many after light and moderate release. Despite the actual decrease in sprouts on the lower bole, the net change per tree is an increase associated with degree of release in thinning.

It appears that in second-growth yellow-poplar the number of epicormic sprouts is controlled by the same factors that influence the sprouting of old-growth trees. Most abundant in heavy stands, they are stimulated after heavy cuttings, and are located rather high on the clear stems. Many are on trees in subordinate crown classes, or on injured trees. Few are found on the most valuable parts of saw-log trees—the first two 16-foot log lengths. If good grade lumber is desired from upper logs as well, a light improvement cutting is indicated. The worst sprouted, injured, and suppressed trees apparently can be removed for pulpwood without fear of serious deterioration of the better reserved trees.

[2]This contrast is based on averages only. Statistical analysis of this phase of the study showed no significant correlation between sprouting and degree of thinning. This unexpected result is attributed to inadequate sampling.

TABLE 2.—EFFECT OF THINNING ON AVERAGE NUMBERS OF SPROUTS

	Below 33 feet	Above 33 feet	Entire bole
	Sprouts per tree		
Light release			
1939	7.8	5.0	12.8
Change	—4.5	+8.2	+3.7
1949	3.3	13.2	16.5
Moderate release[1]			
1939	10.4	4.6	15.0
Change	—3.4	+7.6	+4.2
1949	7.0	12.2	19.2
Severe release			
1939	9.6	7.7	17.3
Change	—1.4	+10.3	+8.9
1949	8.2	18.0	26.2

[1]Moderate release removed timber at the rate of 30 to 57 square feet of basal area per acre around these sample trees. In marking for a "moderate" thinning, removals are best judged tree by tree, taking only 2 to 4 square feet of basal area within a radius of about 30 feet. In this study the basal area cut was estimated from stump tallies on 0.07 acre circles, i.e., within a radius of 31.2 feet from each sample crop tree. Removing less than 2 square feet is called light release, and more than 4, severe release. Basis: 50 trees.

Decay Resistance and Physical Properties Of Wood[1]

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IN HIGHLY durable woods, due to differences in the amount and toxicity of extraneous materials such as tannins, volatile oils, and other extractives, resistance to decay often varies with position in the tree. The information on less durable woods is somewhat conflicting. Some evidence (*3*) points to a relationship between position and durability, while other work indicates the contrary (*12, 14*).

The literature also reveals conflicting reports on the relationship between decay resistance and specific gravity. Some workers (*1, 11, 15*) have found a definite relationship between specific gravity and decay resistance, while others (*1, 11*) have questioned the significance of such a relationship. It is the purpose of this paper to present some additional evidence on the effect of position in the log and specific gravity on the decay resistance of sapwood.

Materials and Methods

Two 6-foot logs, one of loblolly pine (*Pinus taeda* L.) and one of red gum (*Liquidambar styraciflua* L.) furnished all the decay samples in this study. These logs were quarter sawn into 1-inch boards which were then kiln dried on a mild schedule to 6 percent moisture content. The sapwood portions of several of these boards were cut into small beams $\frac{1}{2}$ by $\frac{1}{2}$ by 6 inches and labeled with a three-element label which located each piece exactly with respect to its longitudinal, radial, and periclinal position in the log. The pieces were then brought to equilibrium at 7.7 percent moisture content, weighed, and the original oven-dry weight calculated.

For each fungus 64 pieces were employed, 56 of which were actually decayed and 8 controls which received every treatment except decay. In each study samples were used from four longitudinal positions spaced 15 inches on center down the log, and from four periclinal positions spaced 90 degrees apart around the log. The loblolly pine log in addition furnished four radial positions from the bark inward spaced $\frac{3}{8}$ inch on center. One piece for each of the combinations of the four longitudinal, radial, and periclinal positions formed a 4 by 4 by 4 factorial experiment with no replication and furnished exactly 64 pieces.

The red gum log with its narrower sapwood furnished only three radial positions wholly in the sapwood. In this study beams were used from radial positions one and three in the gum log. To build up the required 64 pieces in each red gum study, two beams located side by side in a periclinal direction were taken from each position. This formed a 4 by 4 by 2 factorial experiment with one replication which furnished 32 times 2 or 64 pieces.

Large-mouth jars 6 by 6 by $8\frac{1}{2}$ inches were prepared as decay chambers by placing them on their sides and planting a pure culture of the appropriate test fungus on a sterile malt-agar substratum. For the loblolly pine experiment, eight chambers containing the brown rot organism *Poria monticola* Murr. and eight chambers containing the white rot organism *Polyporus abietinus* (Dicks.) Fries were employed. For the red gum experiment eight chambers containing the brown rot organism *Lenzites trabea* (Pers.) Fries and eight chambers containing the white rot organism *Polyporus versicolor* (L.) Fries were employed.

The test pieces were steamed at atmospheric pressure for 5 minutes and then seven pieces of the appropriate wood were placed in each of the 32 decay chambers. In each decay chamber the test pieces were supported on 3-millimeter glass rods which in turn rested on the mycelial mat of the fungus. The decay chambers were placed in a darkened basement room which was maintained at 80° F. and 80 percent relative humidity. At the end of each 2-week interval up to 14 weeks one piece was removed from each chamber, oven dried, and the percent loss in oven-dry weight calculated. The experiment was so designed that the main effects of position in the log were

TABLE 1.—THE RELATIONSHIP BETWEEN POSITION IN THE SAPWOOD AND PERCENT WEIGHT LOSS DUE TO DECAY[1]

Position numbers	Radial positions from the bark inward, $\frac{3}{8}$ inches on center	Longitudinal positions down the log, 15 inches on center	Periclinal positions separated by 90°
	Loblolly pine decayed by *Poria monticola*		
1	11.1	10.6	10.5
2	10.5	11.8	10.4
3	11.1	9.7	11.4
4	10.4	10.9	10.7
	Loblolly pine decayed by *Polyporus abietinus*		
1	5.7	6.1	5.5
2	5.4	6.1	5.9
3	5.9	5.2	6.1
4	6.5	6.1	5.9
	Red gum decayed by *Lenzites trabea*		
1	10.4	8.8	12.0
2		12.6	11.3
3	12.0	13.8	10.2
4		9.6	11.3
	Red gum decayed by *Polyporus versicolor*		
1	10.6	11.4	11.0
2		13.7	11.3
3	12.9	10.3	12.8
4		11.6	11.9

[1] Each average is based on the percent weight loss for 14 test pieces except for radial positions 1 and 3 from red gum where each average is based on 28 test pieces.

[1] The data for this study were part of a Ph.D. thesis at the N. Y. State College of Forestry, prepared under the supervision of Dr. R. A. Zabel and Dr. R. H. Hart.

TABLE 2.—AVERAGE PERCENT WEIGHT LOSS VALUES FOR DIFFERENT SPECIFIC GRAVITY GROUPS

Wood	Fungus causing the decay	Specific gravity classes of the wood prior to decay .40-.41	.42-.43	.44-.45	.46-.47	.48-.49	.50-.51	.52-.53	.54-.56
Loblolly pine	*Poria monticola*		13	15	9.8	10.8	7.7	8.3	15
Loblolly pine	*Polyporus abietinus*		4	8	4.7	6.5	5.3	6.8	6.5
Red gum	*Lenzites trabea*	7.1	11.5	11.6	13.2	18			
Red gum	*Polyporus versicolor*	10.7	10.8	12.6	15				

not confounded with the effects of these different times of decay. This meant that the eight pieces removed at one time from the eight jars of any one fungus had exactly the same number of pieces from each longitudinal, radial, and periclinal position in the log as did the eight pieces removed at any other time period.

Results

No significant relationship was found between decay resistance and the different longitudinal, periclinal, and radial positions within the sapwood of either red gum or loblolly pine. Table 1 indicates this fact in a general way. Although this table still includes the variability due to different decay periods, the experiment was so designed that this extra variability does not bias the data with reference to any of the positions, but merely increases the overall variability. In studying Table 1, it might appear that there was a slight tendency for radial position 3 in red gum to decay more rapidly than position 1. A detailed analysis of variance detected no significant relationships due to position in the sapwood of the log. However, for radial positions in the *Polyporus versicolor* study a variance ratio, F (*10*), of 3.72 was calculated (*5*) which approaches 4.07, the theoretical 5 percent value of F. This indicated that more information on the subject might be of interest, but until further evidence is obtained, these radial differences must be considered as only random variation.

Since the pieces of different specific gravity were not located in the matrix of the experimental design with any preconceived plan, it is possible that the effect of different decay periods may have distorted the general picture of what happened due to specific gravity differences. For this reason little meaning can be assigned to the tabulated values or the gross regression coefficients in Tables 2 and 3. To eliminate any variability due to the different decay periods and decay chambers an analysis of covariance (*10*) was resorted to (Table 4). The error regression from this analysis shows the true relationship between specific gravity and percent weight-loss when freed of the effect on weight-loss of decay chambers and decay periods. This additional analysis still failed to detect any significant relationship between original specific gravity and weight-loss due to decay.

TABLE 3.—THE RELATIONSHIP BETWEEN THE ORIGINAL SPECIFIC GRAVITY OF THE WOOD AND THE PERCENT WEIGHT LOSS DUE TO DECAY AS SHOWN BY THE GROSS REGRESSION COEFFICIENT[1]

Wood	Fungus causing the decay	Errors of estimate: Sums of squares	Errors of estimate: Degrees of freedom	Coefficient of regression of percent weight loss on specific gravity times 100	Student's t
Loblolly pine	*Poria monticola*	4425.5	54	0.37	0.842
Loblolly pine	*Polyporus abietinus*	1146.9	54	0.00	0.002
Red gum	*Lenzites trabea*	5768.0	54	1.37	1.642
Red gum	*Polyporus versicolor*	3917.6	54	0.49	0.642

[1]The large variations due to different decay chambers and decay periods has not been removed.
[2]Not significant.

TABLE 4.—THE RELATIONSHIP BETWEEN ORIGINAL SPECIFIC GRAVITY OF THE WOOD AND PERCENT WEIGHT LOSS[1]

Fungus causing decay	Errors of estimate: Sums of squares	Errors of estimate: Degrees of freedom	Coefficient of error regression (*10*) of percent weight loss on specific gravity X 100	Student's t
Poria monticola	560.7	41	0.049	0.262
Polyporus abietinus	71.9	41	0.044	0.602
Lenzites trabea	1647.1	41	0.528	0.982
Polyporus versicolor	738.6	41	0.142	0.342

[1]The variation due to decay chambers and decay periods has been eliminated by an analysis of covariance (*10*).
[2]Not significant.

Discussion and Conclusions

Since the data for each species of wood were collected from a single log, the basis for generalization is rather limited; for the conditions of this experiment, however, a significant relationship was detected neither between position in the log and decay resistance nor between original specific gravity and decay resistance.

The results for position in the log differ from those reported for certain other woods (*2, 3, 6, 7, 8, 9, 12, 13*), but are in general agreement with the work of Zeller (*14*) on southern pine and with the work of Woodruff (*12*) on maple and white pine. In general those species which have shown a relationship between position and decay resistance are species of from moderate to high natural durability. Since the present study deals only with two very non-durable sapwoods, the results are not necessarily in conflict.

The results on specific gravity and decay resistance differ from the conclusions of some (*4, 11, 15*) while agreeing with those of others (*1, 11*). It should be noted that the present study does not take into account any durability differences between different trees which might be associated with differences in the average specific gravities of the different trees.

Summary

Pieces of the sapwood of loblolly pine and red gum were subjected to decay by pure cultures of white and brown rot organisms. Samples were removed at 2-week intervals up to 14 weeks and the weight-loss due to decay was calculated as a percentage of the original oven-dry weight. For the conditions of this experiment neither position within the sapwood of the log nor original specific gravity had any consistent effect on the decay resistance of the wood.

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Effects of Some Growth Regulators and Dressings on the Healing of Tree Wounds

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Summarizing the results of a series of 11 studies of tree wounds, the author concludes that lanolin has proved to be consistently effective as a wound-dressing material. Shellac and growth regulators did not promote healing of wounds.

THE WORK here reported was begun in 1942 as one of several series of studies on tree planting and maintenance undertaken at the request of the Camouflage Branch, Army Engineer Board, Fort Belvoir, Va. Under the threat of possible bombing at that time, new buildings at Army posts were being dispersed wherever feasible through wooded areas, and there was much interest in the use of both wild and planted trees for camouflage purposes. Since trees growing in and near the centers of human activity are subject to injuries of many sorts, the Camouflage Branch was concerned with techniques for wound treatment that would promote rapid healing and preserve the life and vigor of the tree.

The field tests were carried out at the Beltsville Experimental Forest, a Forest Service unit of the Agricultural Research Center at Beltsville, Md., with the Bureau of Plant Industry, Soils and Agricultural Engineering cooperating in the planning and technical aspects. Contacts with the Army were through a liaison arrangement between the Camouflage Branch and the Department of Agriculture.

Altogether, 11 separate but related studies were begun during the period 1942-45[1]. In 1946, because of changing emphasis in postwar activities within the Forest Service, and shifts in personnel, the work was drastically curtailed. Only an imperfect record of observations was obtained for the later studies. Ten of the studies were terminated in 1947; for the eleventh, dealing with increment-borer wounds, we hope to make one more examination. This report is a summary of results from the entire series, with many details omitted. Anyone wishing more detailed information is invited to communicate with the author.

Procedures

All the tests were carried out in natural, second-growth woodland on trees ranging from 7 to 20 inches in diameter. Practically every species available in adequate size and numbers was used in one or another of the experiments. The standard test wound, unless otherwise indicated, was an elliptical cut, 3 by 1.5 inches, made with a punch. After making this cut well through the cambium, the wound was cleaned down to raw wood and the bark was bevelled at the bottom for drainage. In every test save one, all chemical treatments involved were applied on each tree. Where many wounds were required, they were arranged in a spiral or staggered pattern around the trunk so as to leave several inches, both laterally and vertically, between wounds.

The first 6 of the 11 studies were started in the fall of 1942. Study I was mainly a test of several kinds and concentrations of growth regulators in two carriers—lanolin and orange shellac—plus untreated controls. Included also were two other chemical treatments in the same carriers—traumatic acid, a wound hormone first isolated from string beans, and a mixture of sugar, yeast, and nutrient mineral salts. The growth regulators were indoleacetic, indolebutyric, naphthaleneacetic, and naphthoxyacetic acids, and naphthalene acetamide. Concentrations varied from 0.1 to 4.0 percent. Total number of wounds per tree was 32. Other experimental variables were season of wounding (fall, winter, and spring), immediate vs. delayed treatment of wounds, shading with cloth vs. no shading of wounded trunks, and seven tree species—red maple, black gum, beech, white oak, scarlet oak, pitch pine, and Virginia pine. Each ultimate wound series was replicated on three trees. Total number of trees involved was 252.

Studies II to V were comparatively minor experiments designed to supplement certain aspects of Study I. They will be briefly explained as the results are discussed later.

Study VI was a test of the effect of mineral fertilizers in conjunction with growth-regulartor treatments to stimulate wound healing. There were 12 wound treatments per tree, consisting of control, shellac on the edge plus plastic asphaltum on the wood face, and 10 treatments composed of varying amounts of growth regulators in lanolin. The soil fertilizers comprised three levels of nitrogen, each of which was combined with three levels of phosphorus and potassium. These were broadcast under the tree over a circular area, the size of which was determined by a radius in feet equal to 1.5 times the trunk diameter at breast height in inches. The three levels of N were 0, 125, and 375 pounds per acre; for P_2O_5 and K_2O, the three levels were respectively 0-0, 150-80, and 450-240 pounds per acre. Two seasonal series (December and April) were installed on two species—white oak and pitch pine. With nine fertilizer treatments, and the ultimate sets replicated on three trees, total number of trees involved was 108.

[1] A number of people participated in these studies. Dr. C. L. Hamner, then of the Bureau of Plant Industry, Soils and Agricultural Engineering, and Dr. E. J. Kraus of the University of Chicago, then serving part-time with the same bureau, were responsible for planning the growth-regulator treatments and the technical aspects of their application. For the Forest Service, T. E. Maki, of the Northeastern Forest Experiment Station, was in charge and took an active part during the first 2 years; Dr. Elbert L. Little, Jr., planned and supervised some of the earlier installations; and Dr. Carl E. Ostrom assisted at times in the statistical aspects. Most of the field work was done by men from Civilian Public Service Camp 34. One of these, Joseph W. Showalter, was responsible for all routine field work, summarization of data, and preparation of progress reports up to the time of his discharge. His work is especially commended.

Study VII was a test of several lanolin admixtures and other combinations as wound dressings. The idea of lanolin admixtures stemmed from the observation in earlier studies that lanolin possessed desirable properties as a dressing and that, when applied to wounds on pines, those properties seemed to be enhanced by the incidental blending with exuding pitch. The test series consisted of lanolin alone, lanolin with crude pine gum, with linseed oil, with turpentine, with rosin, with rosin plus finely ground charcoal and mineral nutrients, with rosin plus 0.75 percent tryptophane, with 1 percent propionic acid, lanolin on the edges plus overcoating of entire wounds with Bordeaux paste, lanolin on edges and overpainted with asphaltum, orange shellac on edges and overpainted with asphaltum and two untreated controls, making 13 wounds per tree. The tests with tryptophane, a chemical allied to the growth regulator group, and propionic acid, a mold inhibitor, were included as "long shots" at the suggestion of Dr. Kraus. The treatments were replicated three times on three species (white oak, scarlet oak, red maple) three seasons (July, November, March), and two exposures (north and south), requiring 54 trees altogether.

Study VIII, started in 1944, was an extension of Study VII. It included two phases—a weathering test of 140 different experimental formulations, all but 10 of which contained lanolin, and second, a test of 25 of these formulations on freshly made wounds on three white oak trees. The formulations were various combinations and proportions of lanolin, rosin, beeswax, tallow, linseed oil, paraffin, crude pine gum, cod liver oil, asphaltum, lamp black, and infusorial earth. The weathering tests were made in simulated wounds on three-board panels placed under different exposure conditions in the woods.

Study IX, also started in 1944, extended the investigations to pruning wounds; all previous tests had been on wounds systematically placed on the tree trunks within reach from the ground. The treatments consisted of shellac alone over the entire wound, shellac overpainted with asphaltum, shellac overpainted with lanolin-rosin (proportions 100-40), lanolin-rosin alone, lanolin-rosin plus finely ground charcoal, and lanolin-rosin plus mixtures of four growth regulators in total concentrations of 0.01, 0.05, and 0.15 percent. With a control, this made 9 treatments. These were applied to three species (white oak, pin oak, and sweet gum) in two seasons (March and September). The wound treatments were divided into two series, each of which was installed in duplicate on each of six replicate trees. Total number of trees used thus was 72. Only wounds from pruning live limbs were used in the tests. In general, wound sizes were held within the range of 1 to 3 inches in diameter.

Study X, started in 1944, consisted of two rather simple experiments to determine the ability of trees to form callus directly on the face of wounds. This type of healing had been described by Fenner (*1*) and sporadic instances of it had been observed in our work. According to Fenner, the basic requirements are shade and living cambium on the face. He advocated efforts to induce this type of healing in shade-tree wounds when the cambium remained more or less intact after the injury.

The first experiment was a comparison of all-over dressings of lanolin and shellac, shellac only on wound edges (Fenner's recommendation), and no treatment, on wounds where the cambium remained largely intact over the wound face. The wounds were 3 by 6 inches, elliptical in shape, and all placed on the north side of the trunks. No additional shading was provided. These four treatments were replicated on three white oaks. The second experiment, in 1945, consisted of two pairs of 3- to 6-inch elliptical wounds per tree, one pair shaded with cloth, and one unshaded. The cambium was left on all wound faces. One wound of each pair was shellacked on the edges (Fenner method), the other dressed all over with lanolin. Eight trees—4 white oaks and 4 red maples—were so treated. The wounds faced west on half the trees and east on the others.

Study XI, started in the fall of 1944 and not yet concluded, deals with the wounds made by use of an increment borer. All test wounds were 4 inches deep. The following 10 treatments were used: (1) untreated control; (2) hole tightly plugged with a black locust dowel; (3) same as 2 except the hole and dowel were first disinfected by swabbing with 0.1 percent mercuric chloride solution; (4) plugged with lanolin-rosin-asphaltum in proportions 1-1-2; (5) same as 4 except hole was first swabbed with mercuric chloride solution; (6) plugged with lanolin-Bordeaux powder in proportions 10-2; (7) injured bark trimmed around wound to diameter of about 1 inch and dressed with lanolin-rosin in proportions 10-4, inner hole not plugged; (8) same as 7 except hole was first swabbed with creosote; (9) plugged with commerical putti rope; (10) same as 9 except hole was first swabbed with mercuric chloride.

Three species, viz., white oak, red maple, and sweetgum, were treated in October, March, and June. Three additional species—yellow-poplar, beech, and river birch—were treated only in October and March. Three replicate trees were treated each time. One extra tree of each species was treated in October for early felling and dissection. Total number of trees used was 51. The extra trees above mentioned were taken out in October 1947 and their condition is discussed below. The remaining trees still stand. If circumstances permit, some or all of these will be felled and dissected at a later date, and the study will then be formally concluded.

All together in the 11 studies, 646 trees were used, most of which had a dozen or more wounds. The total number of wounds involved was 13,560.

Results

Tree wounds heal mostly from the sides. Consequently the most important single measure of healing is the amount of lateral closure, or its reciprocal—the width of wound face remaining open. The latter is easily measured with an inside caliper, and this was the basis for most of the comparisons in this study. Various other observations were made and considered in the final evaluations. Among these were initial die-back (laterally and vertically), vertical closure, condition of dressing, checking of wound face, and presence of molds or insects. The rather voluminous field data were summarized and analyzed statistically from time to time as seemd necessary for interpreting current developments.

The statements of results appearing below, although made with little elaboration or explanation of the exact basis for their acceptance, are founded upon careful examination and analysis of a great mass of data.

In the first study, the 32 wounds per tree were arranged in two spirals extending from 1 foot to 7 feet from the ground, and encircling the tree twice. Two questions arose in using this design: (1) Would the tree be so severely injured by this number of wounds that it could not respond normally to the wound treatments? and (2) With the spacings used, would a given wound be effected by growth regulator chemicals applied to a neighboring wound? The supplemental studies numbered II to V were made to provide some information on these uncertainties.

In one experiment, intensities of wounding varying from 16 to 128 wounds per tree within the 1- to 7-foot height zone showed that the 32 wounds per tree in Study I was a safe intensity. Double that number apparently could have been tolerated without loss in healing response. One tree in four with 128 wounds died; the other three showed no decline in vigor. Another experiment carried the intensity theme to the limit—the trees were completely girdled by two continuous spirals corresponding to the pattern of wound placement in Study I. Vertical translocation of solutes in the phloem thus could take place only by following the course of bark between the spirals. Here 7 of 14 test trees died. Red maple, black gum, and beech withstood this type of girdling better than the oaks and pines. These results, however, did not affect the acceptance of 32 as a safe number of wounds for experimental work.

Two experiments were made to ascertain whether growth regulators were translocated from the place of application, i.e., whether treatment of one wound with these substances would affect neighboring wounds. The tests were done by treating certain wounds in variously spaced and variously arranged groups, and observing effects on all wounds in the group. Some evidence of growth regulator translocation was obtained, but the results as a whole were not conclusive. Effects, if any, of growth regulators applied on another wound 2 inches or more distant were erratic and generally not significant.

Results and conclusions as regards the major aspects of the studies were as follows:

Growth Regulators and Other Specific Chemicals

The growth-regulator chemicals as applied in wound coatings were definitely injurious in the higher concentrations used; at lower concentrations (0.1 percent and less) their effects were inconclusive. No growth-regulator treatment was found that significantly increased the rate of wound healing in any tree species. Likewise, none of the other specific chemicals tested was beneficial.

Dressings

Shellac consistently was a poor treatment in these tests; wounds so treated healed only slightly better than controls.

Lanolin alone, and in blends with rosin and pine gum, were good dressings. The beneficial effects came mainly from the protection of the wound edges against drying and resultant die-back. With this protection, callus forms at the wound edge; without it, the cambium and phloem die back as much as an inch or more under the bark, and healing must start from there. Moreover, during the period of dying back there can be no differentiation of callus from the phloem and cambial tissues and no start toward healing. The more rapid closure of lanolin-treated wounds thus was due primarily to the prevention of wound enlargement and to prompter initiation of callus growth. However, lateral growth of callus after its initiation also tended to be slightly faster on lanolin-dressed wounds than on untreated controls. In a comparison involving 45 trees divided among 5 species, this increase in callus growth for 1 year averaged 14 percent. This is not great enough to be of much significance on small wounds, but if it could be maintained on larger wounds it would be a worth-while advantage.

In physical properties, blends of lanolin and rosin in proportions of about 10 to 4, or lanolin-rosin-pine gum in proportions of 10-2-2, were superior to lanolin alone. The blends were more elastic; they tended to form a film that remained intact remarkably well as the topography of the wound area changed during development of the callus, and they were workable over a fairly wide range of temperatures. Lanolin alone was more sticky, less pliable over an expanding callus, and more sensitive to temperature. On very warm days fresh lanolin in the sun would melt and run. Healing under lanolin alone and under its better-appearing blends was essentially the same except where melting and runoff had occurred.

Plastic asphaltum over shellac did not give the physical appearance of a good dressing: it became brittle and cracked or curled away from the wood after a few months. However, healing under this dressing compared favorably with that under lanolin. Evidently the shellac-asphaltum combination provided good protection during the crucial period prior to callus dif-

ferentiation, and deterioration later made little difference.

Bordeaux paste (Bordeaux powder and raw linseed oil) over shellac was not a satisfactory dressing. It soon became brittle and cracked. Moreover, it is likely to be toxic to the cambium.

The weathering test of dressing materials (Study VIII) failed in its original purpose. Most of the substances, except those that melted and ran, still were in good condition after 4 years' exposure. However, as became increasingly evident after the weathering test was set up, deterioration of dressings on live wounds is in large part induced by changes in wound topography during the die-back and healing processes, and by exudations that may diffuse into the dressing, loosen it from the wound surface, or affect it indirectly by fostering the growth of molds and bacteria. Mere weathering seems to be of secondary importance. Hence durability on the exposure panels did not prove to be a good measure of durability in actual service.

Tree Species

Very striking differences in rate of healing were found between species. White oak was consistently the fastest healer among the species used in these tests. It usually suffered relatively little die-back at the wound edges, and callus growth was relatively rapid. With the better treatments, many of the standard 1.5- by 3-inch wounds closed in one year, and a majority under all treatments were closed at the end of two years. Black gum behaved similarly, with little die-back and with callus growth almost as rapid as in white oak. Red maple was one of the slowest hardwoods to heal, mainly because it usually underwent excessive die-back. Its tendency to bleed reduced the efficacy of dressings. Callus growth, when established, was reasonably rapid, but often a year or two more were required for the callus to recover the area lost by die-back, thus greatly prolonging the time required for the wound to close completely. Scarlet oak was also subject to considerable die-back, and hence rather slow to heal. Beech did not die back severely but was a slow healer simply because of slow callus growth. Pin oak, observed only in the pruning-wound study, healed fully as vigorously as white oak. Sweetgum in the pruning study was more subject to vertical die-back, but otherwise was a relatively rapid healer.

The pines were notoriously slow to heal, solely because of slow callus growth. Because of pitch exudation in the wounds, there was little die-back and no evidence of fungus infection. After 2 years, the wounds on Virginia pine had not healed enough to warrant measurement; on pitch pine the original wound widths for all treatments had been reduced, on the average, about 30 percent.

Season of Wounding

In general, with the exception of red maple, wounds made in late winter or early spring healed faster than those made in the fall or late spring and summer. Red maple wounds healed best when made in late spring or early summer (May-June). In this species, healing apparently is retarded in early spring wounds because of excessive bleeding.

Orientation and Height of Wounds

Fall wounds seemed to heal better if facing south, whereas spring and summer wounds healed better when on the north or shaded side of the trunk. Among series of wounds on the same tree, the lower ones tended to heal better than the upper ones. These are apparent tendencies of minor importance; they are not offered as definite conclusions.

Fertilizer and Tree Vigor

Considerable variation in rate of healing occurred between trees of the same species, presumably due to differences in vigor. Increase in growth vigor through applications of fertilizer might therefore be expected to increase rate of wound healing. This effect was obtained in white oak. Two years after treatment, increases in growth rate, determined from increment cores, ranged from 0 up to 86 percent among the nine fertilizer combinations. Statistical analyses showed that the growth responses were influenced more by the amount of nitrogen than by phosphorus and potassium. The rate of healing likewise was accelerated by the fertilizer treatments (up to a maximum of 66-percent increase over no fertilizer) on trees receiving the high level of nitrogen with the intermediate level of phosphorus and potassium. As with diameter growth, nitrogen was the most influential element.

Pitch pine—the other species in the fertilizer experiment—was less responsive. Small statistically significant increases in diameter growth were induced by fertilizers, but differences in wound healing were not significant.

Surface Callus

Proliferations of tissue on wound faces occurred sporadically in several of the experiments. Whether these developed from wood-ray cells or from remnants of cambium was never positively determined. Though most such surface growths died out within a few months, occasional ones developed a periderm with a green cambium-like layer beneath, and became a permanent part of the callus overgrowing the wounds.

In the two small experiments set up under Study X to test possibilities for inducing surface callus to form, the first (on three white oaks, no artificial shade) yielded some temporary proliferations but no permanent tissue. In the second experiment (4 white oaks, 4 red maples, with and without artificial shade), five of the total of 32 wounds exhibited areas of living surface callus ranging from 30 to 80 percent of the wound face 2 years later. Seven other wounds had sizeable areas of surface callus that appeared to have died. Callus formation was scattered among the treatments on both species; no condition stood out as markedly more favorable than others for such growth. Considering that the cambium was left over the entire faces of these wounds, and other conditions were as favorable as was known how to provide, the prospects for inducing formation of permanent surface callus in any

substantial proportion of accidental wounds seem rather remote.

Pruning Wounds vs. Wounds on Clear Bole

Except for some first-season observations, no data on healing of the pruning wounds were obtained until the fall of 1947. The March installation had then gone through four summers, and the September installation through three. Of the 432 wounds in the dressings series, 248 (57 percent) had closed. At this late stage, width-of-callus measurements had lost much of their value because they did not distinguish between the varying lengths of time required for different closures to take place. Sensitive treatment comparisons therefore were impossible. The best remaining basis for comparisons was numbers of wounds closed, which—expressed in percents (species and seasons combined)—were: untreated controls—49, shellac alone—43, shellac plus asphaltum—65, shellac plus lanolin-rosin—68, lanolin-rosin alone—64, and lanolin-rosin-charcoal—58.

By this criterion, shellac alone showed no benefits, whereas the other four dressings all apparently increased rate of healing. Mean percent closed for the latter four dressings is 64, as compared to 49 percent for controls. Taking closures of controls as a base, this difference of 15 percent represents about a 30-percent increase in closures due to dressings.

Pruning wounds and clear-bole wounds showed the same general reactions to treatments, i.e., healing the best under lanolin or asphaltum dressings. Shellac coatings alone were of little or no value, and no beneficial effects were obtained from growth regulators. Pruning wounds, however, healed somewhat more slowly, probably because of the slight protuberances that remained even after careful flush pruning. White oak, the only species common to both the pruning and other studies, furnishes the best measure of this difference in healing rate. White oak pruning wounds of the March installation averaged 2.06 inches wide, and most of them were closed after four summers. Thus they closed laterally at approximately 0.5 inch per year. In other studies, similarly treated clear-bole wounds 1.5 inches wide closed to about the same extent in 2 years, or at a rate of 0.75 inch per year.

Though no definite comparative data are available, pruning wounds obviously were more subject to infections, as evidenced by wet-wood and slime-flux conditions. This doubtless was related to the presence of heartwood in some pruning wounds. Where such infections occurred, healing was much retarded. Of 31 badly infected pruning wounds noted, 15 were untreated, 7 had been shellac-coated, and 9 were distributed among the other 7 treatments. From this it may be inferred the lanolin and asphaltum dressings provided some protection against infection as well as against drying and die-back of the wound edges.

Increment Borer Wounds

Dissection of the six trees removed in 1947 (three growing seasons after wounding) revealed some evidence of incipient wood decay, notably in red maple, red gum, and beech, but no correlation of decay conditions with treatments was discernible. All but 4 of the 60 wounds examined were closed. All species except white oak showed more or less staining in a vertical strip upward and downward from the wound, as described by Hepting et al (2). The deep blue-black stain formed in yellow-poplar was particularly striking.

In view of Hepting's statement that the birches (paper, sweet, and yellow) underwent more extensive discoloration than any other species in their experiments, the behavior of river birch in our tests is of interest. All 10 wounds on the one river birch dissected were closed; there were no cankers, no obvious rot, and the stain was less conspicuous and less extensive than in any of the other five species except white oak.

In general, however, our preliminary observations are in accord with Hepting's report. Though the incidence of cankers was lower among our trees, we found the same general types of discoloration, and the same failure or plugs or wound treatments to prevent the undesirable after-effects of increment boring.

Discussion and Conclusions

Chief among the general conclusions to be drawn from the wounding studies are these: (1) That wound treatments do not greatly alter the rate of callus growth; and (2) that a main function of a wound dressing is to prevent drying and resultant die-back, thereby facilitating early differentiation of callus at the wound edge. A second function of a dressing, not much explored in these studies except in increment-borer wounds, is to prevent infection. Differences in rate of healing, other than those due to species or tree vigor, come about mostly from differences in the amount of die-back or wound enlargement, and the correlated differences in time required for the dying-back to run its course and permit callus differentiation to take place. Once callus has been initiated, its rate of spread over the wound face may be almost or fully as fast without dressings as with them—so long as no other factors come into play. Spread of callus may be retarded, however, by toxic chemicals in a dressing, or by slime flux from an infection.

In the literature on tree wound treatment, shellac has been reported in several instances as one of the most effective dressings. Without reviewing the subject, Nank's study (3) may be cited as an example. Comparing shellac, Bordeaux paste, and three trade-name dressings on wounds of English elm, his shellac-treated wounds healed best of all. Contrary to this and other reports, our shellac-treated wounds consistently healed little or no better than untreated controls, and definitely more slowly than those coated with lanolin or asphaltum. The reason for this discrepancy is not apparent. Our shellac was freshly prepared by dissolving the dry orange flake lac in alcohol. That used in the first

studies contained 20 percent flakes by weight; in later work the proportion was increased to 40 percent, but with no marked difference in effect upon healing.

Probably the most important result of this work was that it demonstrated the potentialities of lanolin as a base for tree-wound dressings. Very few references to lanolin are to be found in the literature and no commercial dressing is known to the writer that contains lanolin as a basic ingredient.

The first published mention of lanolin as a wound dressing is believed to be in a paper by Shear (5) in 1936, in which he reported it as beneficial, and superior to white lead paint. In 1940, however, Tilford (6) reported some apparent cambial injury from lanolin, and poorer healing than with asphaltum. In 1945, a brief report (4) on some phases of the present work was published, in which the beneficial effects from use of lanolin and certain lanolin blends were pointed out. Subsequent results serve only to confirm further that earlier report. The performance of lanolin, both alone and in blends with rosin and pine gum, has been so consistently good in these experiments as definitely to establish a place for it among proved wound-dressing materials. In retention of plasticity it is much superior to asphaltum. Lanolin-rosin blended in proportions of 10 to 4 is suggested as a basic mixture. The viscosity of this can be increased by adding beeswax, or decreased by adding crude pine gum. Blending is done simply by mixing the substances together in a melted state.

It should be recognized in evaluating these studies that the test wounds were relatively small, that most of them were on sapwood and therefore less susceptible to infection than where heartwood is exposed, and that no comparisons with trade-name wound dressings were made. Hence the value of lanolin, though well demonstrated on the small wounds, remains to be confirmed for larger heartwood wounds. Painting heartwood wounds with shellac as a sterilization measure before applying lanolin, as was done in the pruning study, will likely prove to be a good combination. The efficacy of antiseptic substances incorporated into lanolin mixtures should be investigated. These dressings should be compared with various trade-name preparations on a wide range of species. Only then will the general utility of lanolin as a dressing material be fully determined.

Summary

1. A series of 11 studies dealing with treatments to promote healing of tree wounds is described. The treatments involved several substances used as dressings, with and without incorporation of growth regulator and other chemicals. Other variables were tree species, soil fertilizer applications, season of wounding, intensity of wounding, orientation and shading of wounds, and kinds of wounds. Altogether, 13,560 wounds, distributed over 646 trees representing 10 species, were made and observed.

2. None of the growth regulator or other specific chemicals significantly increased the rate of wound healing in any tree species.

3. Dressing the wounds with lanolin promoted healing by preventing drying and die-back, thereby allowing callus to form promptly at the wound edges. The physical properties of lanolin dressings were improved by incorporation of rosin and pine gum.

4. Good healing also occurred in wounds painted with shellac and overcoated with plastic asphaltum. Shellac alone was ineffective in promoting healing. As a dressing, Bordeaux paste was inferior to both lanolin and shellac plus asphaltum.

5. The tree species varied greatly in rates of healing and susceptibility to die-back from wound edges. Of the 10 species used in these experiments, white oak was the fastest healer and Virginia pine was the slowest. Red maple wounds often were long in closing because of excessive die-back.

6. Within a species, rate of healing seemed to be correlated with tree vigor. Healing rates were significantly increased in white oak by applications of fertilizer to the soil.

7. Except on red maple, wounds made in late winter or early spring healed faster than those made at other seasons. Because of excessive bleeding in early spring, wounds on red maple healed best if made in late spring or early summer.

8. Callus sometimes developed directly on wound faces from ray cells or fragments of cambium. Attempts to consistently induce the formation of such callus were unsuccessful.

9. Pruning wounds and wounds on the clear bole healed and responded to treatments in much the same manner, except that pruning wounds tended to heal somewhat more slowly.

10. Three seasons after boring, most increment-borer wounds on six hardwood species were closed externally, but no treatment tested had been effective in preventing discoloration of the wood. Not enough time had yet elapsed since boring to reveal correlations, if any, between treatments and wood decay.

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White Grubs in Wisconsin Forest Tree Nurseries[1]

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SEVERE LOSSES are caused by white grubs, i.e., larvae of *Phyllophaga* and related genera, in forest tree nurseries in Wisconsin. As much as 25 percent of the entire stand in a nursery has occasionally been destroyed and the killing of 10 to 15 percent of the trees is not unusual. The roots of conifers are cut or stripped by the grubs, damage being most extensive in the age classes below 2-2 and especially so in 1-0 and 2-1 stock. The losses are serious not only from monetary standpoint but also because of the disruption of planned planting programs.

Studies to discover a means of control were started at the Griffith State Nursery, located near Wisconsin Rapids in the central portion of the state, because the greatest damage has occurred there. The species involved, population trends, and plants eaten by the adults were studied by means of light traps, by picking the beetles from vegetation at night, and by taking soil samples.

Eleven species of *Phyllophaga* were collected as well as numerous other species belonging to the Scarabaeoidea, several of which damage the trees in the same manner as *Phyllophaga*. Judging from the relative numbers of adults captured and from the frequency with which grubs are found in the nursery, the following species are ranked in the order in which they appear to be responsible for damage, beginning with the most injurious:[2]

Phyllophaga tristis (Fab.)
" *rugosa* (Melsh.)
" *drakii* (Kby.)
" *crenulata* (Froehl.)
" *pruinosa* (Lec.)
" *fusca* (Froehl.)
Cotalpa lanigera (L.)
Pseudaeneus placodes (Say)
Phyllophaga anxia (Lec.)
Diplotaxis sordida (Say)

Thirty-four different species of trees or shrubs are fed upon by the adults at the nursery. There are variations both within and between seasons in the extent to which a given plant type is eaten. Incidentally, six of the species of *Phyllophaga* were taken from European larch which was eaten quite freely during one season; and *P. crenulata* was observed feeding on the succulent needles of white spruce. The adult of *D. sordida* rags the needles of Norway pine.

The skunk is the most important natural enemy of white grubs at the nursery, although it does not appear to start eating the grubs until they have attained fairly large size and have done considerable damage. Other predators and parasites are not sufficiently abundant, at present, at the nursery to be of importance in reducing the grub population. The introduction of spores of Type A milky disease of the Japanese beetle has not yet resulted in evidence of establishment of the pathogen.

Results of Experiments for Control[3]

A. Control of Adults

1. Insecticides

a. Field applications.—In early June, 1947, a 50 percent wettable powder of DDT was applied at the rate of 2 lbs. per 100 gallons of water to the hardwood trees and shrubs around the edge of the nursery. A 10-acre field containing much hazelnut brush was sprayed by power machinery at 0.715 lbs. actual DDT per acre around the edge and at 1.43 lbs. over the remainder. Neither type of application gave the desired control. Collections made for 15 minute intervals on sprayed and unsprayed foliage showed that the insects were slightly repelled by the DDT, but 10 days after application the beetles were as numerous on sprayed as on unsprayed foliage. Fifty adults collected from freshly sprayed foliage were placed in rearing cans and given sprayed foliage from time to time as food. After 18 days there was still a 32 percent survival and 44 eggs had been laid.

b. Laboratory tests.—The effectiveness of sprays on foliage was tested by placing beetles in wire-covered containers with approximately the same amount of treated (by dipping) and untreated foliage set in soil. The insecticides used, rate of application per 100 gallons and average percent mortality for all tests were as follow:

	Percent
Chlordane—2 lbs.	97.50
BHC (benzene hexachloride)—0.4 lb. gamma isomer	92.50
Acid lead arsenate—4 lbs.	86.60
TDE (DDD)—2 lbs.	86.25
Basic copper arsenate—4 lbs.	68.13
Paris green—4 lbs.	66.25
DDT—2 lbs.	61.25
Check	40.00

Because of the number of host plants utilized by the beetles, the length of their feeding period, the repellency of sprayed foliage, and the sporadic appearance of the insects, the authors doubt that it would be practical to maintain the spray deposit necessary to kill the

[1] Results of a cooperative project between the College of Agriculture of the University of Wisconsin and the Wisconsin Conservation Department. Approved for publication by the Director of the Wisconsin Agricultural Experiment Station.

[2] Other species which occur at the nursery and perhaps should be mentioned, although they do not appear to be of significance at present, are: *Phyllophaga gracilis* var. *angularis* Glasg., *P. hirticula* (Knoch), *P. dicis* (Knoch), *P. marginalis* (Lec.), *Anomala binotata* Gyll., *A. innuba* (Fab.), *Aphonus tridentatus* (Say), *Dichelonyx albicollis* (Burm.), *D. elongata* (Fab.), *Diplotaxis liberta* (Germ.), *Ligyrus gibbosus* (DeG.), *L. relictus* (Say), *Serica atracapilla* (Kby.), *S. intermixta* Blatch., *S. sericea* (Ill.), and *Strigoderma arboricola* (Fab.).

[3] The writers desire to express their appreciation to the following companies and individuals for their cooperation in supplying materials used in these studies: Commercial Solvents Corp.; Dow Chemical Co.; E. I. DuPont de Nemours & Co.; Dr. C. H. Hadley and Dr. L. H. Haller, U. S. Dept. Agric., Bur. Ent. & Pl. Quar.; Hercules Powder Co.; Koppers Co.; McCormon & Co.; Monsanto Chem. Co.; Pittsburgh Plate Glass Co.; Riverdale Chem. Co.; Rohm & Haas Co., Shell Chem. Corp.; Sherwin-Williams Co.; L. Sonneborn Sons, Inc.; Stauffer Chem. Co.; Texas Gulf Sulphur Co.; United States Vanadium Corp; R. T. Vanderbilt Co.; Velsicol Corp.; and Victor Chem. Co.

adults. Furthermore, it is not known how far the beetles will fly in a night nor how wide a sprayed strip is needed to protect an area.

2. Tests of attractants for June beetles

If attractants could be found which would overcome the repellent effect of spray substances and in addition draw the beetles to particular areas and plants it might be feasible to apply and maintain the necessary cover. Experiments have thus far disclosed no substance sufficiently attractive to be used in this manner but have demonstrated that there are differences in the responses of the species. *P. tristis*, especially, is very sensitive to certain attractants such as cinnamyl alcohol.

3. Preliminary tests of repellents for June beetles

Coal tar and creosote, applied to the screen on frames which were placed over seedbeds after drying, proved unsatisfactory as repellents. Not only did as much grub damage occur under the treated as under untreated frames but both the creosote and coal tar reduced the stand. A stand of 1-0 white spruce was reduced 11.4 percent under coal tar treated frames and 44.6 percent under creosote treated frames.

B. Control of Eggs

Insecticides were prepared for preliminary testing of contact action on eggs of *P. rugosa* by adding to 100 ml. quantities of deobase each of the following: 5 g. of DDT; $2\frac{1}{2}$ g. of TDE; $2\frac{1}{2}$ g. of chlordane; and $1\frac{1}{4}$ g. gamma isomer of BHC. Deobase alone was used as a check. One ml. of the material to be tested was placed on a 70 mm. filter paper in a petri dish. Twenty-five eggs, showing the mandibles through the chorion and apparently about ready to hatch, were placed on the treated paper and rolled about at intervals by a camel's hair brush. After 10 minutes exposure they were transferred individually to filter paper in depressions in a plaster of Paris block. The percentages hatching after the exposure were 16 for BHC, 64 for TDE, 68 for chlordane, 72 for DDT, and 92 for the check.

C. Control of Grubs

1. Trials in petri dishes

A test similar to that described above was made using first instar larvae of *P. rugosa*, but the larvae were transferred to humus containing grass sprouts after treatment. Two days and 4 days after treatment the following percentages were dead: BHC—98 and 100; DDT—84 and 98; chlordane—62 and 96; TDE—80 and 94; check—50 and 96. The larvae were considered as dead when no movement could be observed and pulsation of the blood in the dorsal aorta could not be seen when examined under binoculars.

2. Bait trials with grubs

Tests of bran baits in soil[4] in cages were made by recording the migration of grubs from known points toward the baits. Geraniol-eugenol, anethole, iso-amyl valerate, phenyl ethyl butyrate, and molasses were added to the bran as alternative attractants in several different experiments. Molasses appeared to be the most attractive material used.

[4] The soil involved in this and the tests described subsequently was Plainfield sand obtained at the Griffith State Nursery. The pH of 24 samples taken at the nursery ranged from 4.40 to 5.31 with most samples at about 4.9 according to Dr. S. A. Wilde.

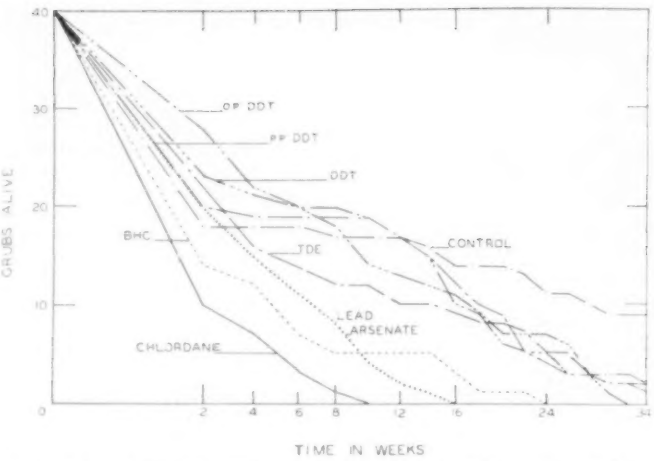

Fig. 1—Effect of different insecticides on survival of white grubs in soil in salve tins.

3. Attempts to poison grubs in soil in salve tins

In early September, 1947, 1,680 grubs were collected behind the plow, the obviously injured ones being left in the field. After being held in soil for 8 to 12 hours, 648 showed symptoms of having been injured and were rejected for test purposes.

Insecticides in dust form were incorporated with soil at rates equivalent to the desired number of pounds per acre in the top 3 inches of soil. The treatments and rates per acre were DDT—10 lbs., o,p' DDT—10 lbs., p,p' DDT—10 lbs., chlordane—10 lbs., BHC—1 lb. gamma, lead arsenate—1,000 lbs., TDE—10 lbs., and an untreated check. Mixed grass and wheat seed was stirred into the treated soil. Forty salve tins were filled with each type, moistened and one grub placed in each tin. Grubs of comparable size selected for each treatment were *Pseudoluecanus placidus*—2, *Cotalpa lanigera*—5, *Phyllophaga spp.*—8 first instar, 5 apparently second instar, and 20 third instar.

The containers were examined every 2 weeks until May 1, 1948, watered and given additional food when necessary, and the dead larvae recorded. In general, it can be stated that the first instar grubs died most rapidly, that the second

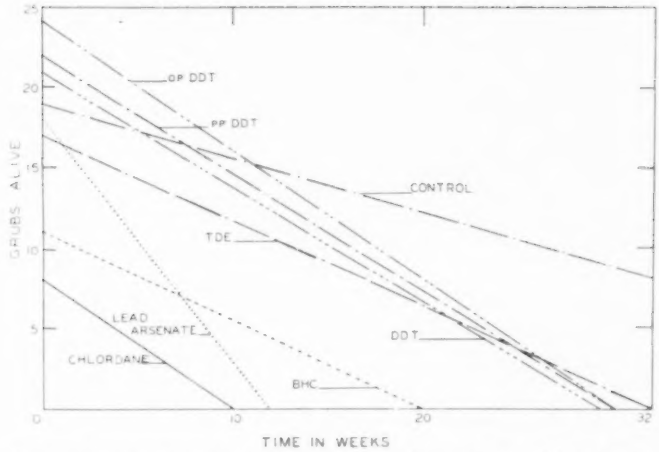

Fig. 2.—Regression lines showing rates of kill of white grubs in sod in salve tins by different insecticides.

instar and *Catalpa* larvae died at about the same rate and that the larvae of *Pseudolucanus* and the third instar *Phyllophaga* were the most resistant.

Figure 1 shows the total number of grubs alive for each treatment at the time of examination, with the time in weeks measured on a square root scale. For the first 2 weeks it is difficult to tell whether or not the differences are due to variations in numbers of grubs injured internally or to differences in the action of the insecticides. Consequently calculated regression lines are given in Figure 2[5] showing the rate of kill after the first two weeks.

This test indicates that chlordane, lead arsenate and BHC were the most effective materials at the dosages used.

i. Tests conducted against grubs in field cages

Figure 3 shows one of the rows of cages in which tests were conducted. Each cage has a lower portion set in the ground and an upper portion.

The tests conducted in cages are grouped under four headings: (a) trials with young grubs (first instar, with probably a few early second instar grubs included); (b) trials with third instar grubs; (c) residual and establishment tests; and (d) soil fumigation trials.

In all cases, except as noted in the tables, four cages were used for each treatment, i.e., there were four replicates. Survival percent as given in the tables is the average for all replicates.

a. Trials with young grubs.—Insecticides were used either as dusts or liquids. In tests with dusts the toxicant was mixed in the top 3 inches of soil in the test cage and grass planted. After the grass began to emerge, 25 larvae were taken from rearing cages, placed at random in small holes one inch deep and covered. Where emulsions or solutions were used the grass was established, the grubs introduced and treatment made 2 days later. The cages were watered by the overhead irrigation system and remained undisturbed until the day of examination. During sifting of soil for larvae in examination of cages, the upper 3 inches of soil was kept separate and replaced on top of the untreated soil when the cage was refilled.

Fig. 3.—South row of cages at Griffith State Nursery.

The grubs used in 1948 included *P. drakii, crenulata, rugosa* and *tristis*. In 1947 *prunina* and *anxia* were also used but *tristis* was not available.

Table 1 summarizes the results obtained.

Tests for phytotoxicity of the emulsions and solutions used were made on 1/10,000-acre plots of seedlings and transplants but no definite symptoms of injury were observed. Experiments are in progress to determine the effects of certain insecticides on germination, on the root systems, and the rates of growth.

b. Trials with third instar grubs.—Ten third instar white grubs were introduced into each of a series of cages in which a sod was established. Insecticidal sprays were applied 1 or 2 days later and washed in with water. The results obtained are shown in Table 2.

c. Residual and establishment tests.—The third type of trial consisted of a test of the ability of insecticide to retain its effectiveness in the ground and prevent establishment of the grubs. Cages treated with insecticide in 1947 were seeded in the spring of 1948 with grass. Adult beetles were introduced, five pairs of *tristis* and ten pairs of *drakii* being placed in each cage. At intervals the insects were given appropriate foliage as food. (The cages treated with sulphur, however, were treated in 1948 and received only five pairs of *drakii* and five of *tristis*).

The cages were examined for eggs and larvae in mid-summer. After counts were made, the soil was replaced, all living larvae and eggs reintroduced, and the cage reseeded. A second examination was made in early fall. Table 3 gives the numbers of larvae found.

d. Soil fumigation trials.—Several soil fumigants were tested against first instar white grubs.

[5]The authors wish to express their appreciation to the University of Wisconsin Computing Service for making the analyses of data necessary in the construction of this figure and the following tables; however, the authors accept sole responsibility for conclusions drawn.

Injections were made with a hypodermic syringe at a depth of 4 inches or application was made by sprinkling, followed by 2 quarts of water per square foot to wash the material into the soil. Ten first instar larvae were introduced into each cage 2 days prior to treating, grass having been established previously. Larvae of *drakii* and *tristis* were used in 1948 and *drakii* and *prunina* in 1947. Table 4 gives the results of the tests.

5. Field applications

Several different tests of insecticides, made in field areas at the Griffith State Nursery, are summarized briefly as follow[6]:

(a). DDT dust applied at 25 and 10 lbs. of DDT per acre on 1/4-acre plots in 1947 over soybeans and plowed into the ground to a depth of about 8 inches did not result in any apparent injury to seedlings planted in the fall nor did it give evidence of reduction of injury by grubs.

(b). BHC dust applied at 1 lb. gamma isomer per acre on a 1/4-acre plot over soybeans and plowed as above gave results similar to those described for DDT.

BHC wettable powder applied at 1 lb. gamma isomer per acre as a spray in May 1948 and washed in by operation of the sprinkling system for three hours was ineffective.

In contrast, BHC emulsion applied at 0.9 lb. gamma isomer per acre to freshly plowed and disced ground appeared to kill the grubs present.

(c). Parathion wettable powder applied as a spray over 1/4 acre at 2.5 lbs. of parathion per acre on August 31, 1948 apparently had not reduced the number of grubs by September 30.

(d). Chlordane emulsion applied at 11¼ lb. chlordane per acre on August 13, 1947 over two 1/4-acre plots where heavy damage was occurring did not have any apparent effect on either trees or grubs by October 9. Application was made with a power sprayer.

Chlordane emulsion applied in 1948 through the overhead sprinkling system at rates varying from 7 to 14 lbs. of chlordane per acre gave varying results. The emulsion was diluted to not more than 1 part in 1800 parts of water for application and the sprinkling system operated for three or four hours afterward to drive the emulsion into the soil.

In one area, in which there was a heavy population of second-year grubs and also numerous *tristis* larvae, severe damage was occurring. The application of chlordane at 14 lbs. per acre on July 9, while reducing the number of grubs (especially between July 24 and August 23) did not prevent the loss of many thousands of trees. The grubs appeared to stop feeding for a time and then resumed their activities. By late fall, however, the population was greatly diminished.

In a second area a heavy population of *tristis* larvae (averaging 7.62 grubs per square foot) was found in 2-0 white pine and Norway pine but damage was very limited. Here the emulsion, applied

[6] Tests for phytotoxicity of the emulsions were made before the field tests and no evidence of acute injury was found. The term 'acute injury' is used here for such rapid injuries as burning of needles, etc. in contrast with 'chronic injury' due to residual activity of insecticides and manifested later in plant abnormalities.

TABLE 1.—SOIL INSECTICIDE TRIALS IN FIELD CAGES AGAINST YOUNG WHITE GRUBS AT GRIFFITH STATE NURSERY IN 1947-48

Insecticide	Toxicant lbs. per acre	Mode of application	Time exposed days	Survival percent	Mean of transformed values[1]
Lead arsenate	1000	dry mix	14	30	1.1228
Lead arsenate	500	dry mix	17	1	0.2509
DDT w.p.	25	dry mix	18	26	1.0550
DDT w.p.	10	dry mix	26	24	1.0123
DDT	10	emulsion spray	28	62	1.8498
Chlordane w.p.	10	dry mix	14	0	0.2003
Chlordane w.p.	2.5	dry mix	30	0	0.2003
Chlordane	10	emulsion spray	28	9	0.5932
BHC w.p.	1 gamma	dry mix	26	0	0.2003
BHC	1 gamma	emulsion spray	27	24	1.0092
TDE	10	emulsion spray	47	57	1.6729
Toxaphene	10	emulsion spray	13	61	1.8854
NMRI 448	10	emulsion spray	45	50	1.5708[2]
Phenothiazine	10	emulsion spray	44	9	0.5377
Mercurous chlor.	8.85	solution spray	43	44	1.4468[2]
Parathion w.p.	2.5	dry mix	14	5	0.4283
Control[3]			15-50	43	1.4102

Analyzing the transformed values, F ratio of variance among to variance within insecticides (15 and 44 D.F. respectively) = 7.812, significant at the 1 percent level.
5 percent L.S.D. = 0.6047 $\sqrt{}$ for insecticide means of 4 transformed
1 percent L.S.D. = 0.8082 $\sqrt{}$ variates based on N = 25.
[1] The fractional survival, n/N for each of 4 (except as noted) replicates transformed to y according to the modified arc sin transformation
(x = 2 are sin $\sqrt{n/N}$ for n/N/0 or 1, y = 2 are sin $\sqrt{1/4}$ 4 N, n = 0;
y = π 2 are sin $\sqrt{1/4N}$, n = N, where n = number of grubs recovered).
The numbers recorded as means are means of the transformed values.
[2] Mean of two replicates.
[3] Replicated once in 1947 and three times in 1948—values not used in analysis.

TABLE 2.—SOIL INSECTICIDE TRIALS IN FIELD CAGES AGAINST THIRD INSTAR WHITE GRUBS AT GRIFFITH STATE NURSERY IN 1948

Insecticide	Toxicant lbs. per acre	Mode of application	Time exposed days	Survival percent	Mean of transformed values[1]
Parathion[2]	2.5	w.p. susp.	37	30	1.1593[3]
Parathion	198.2	1/1000 soln.	36	10	0.6224
DPP[4]	50.4	1/2000 soln.	32	0	0.3176
Control			35,40	40,50	0.8752[5]

Analyzing the transformed values, F ratio of variance among to variance within insecticides (2 and 7 D.F. respectively) = 8.907, significant at the 5 percent level.
5 percent L.S.D. = 0.3854 for insecticide means of 4 transformed variates based on N = 10.
[1] See Footnote 1 Table 1.
[2] Definite stimulation of grasses and weeds occurred with this treatment.
[3] Mean of two replicates—control not included in analysis.
[4] Diethyl paranitrophenyl phosphate.

TABLE 3.—RESIDUAL AND ESTABLISHMENT TRIALS IN CAGES AT GRIFFITH STATE NURSERY IN 1948

Insecticide	Dosage lbs. per acre	1st reading date	Grubs found Total No.	Mean of transformed values[1]	2nd reading date	Grubs found Total No.
Lead arsenate	500	July 26	114	5.25	Sept. 8	7
DDT w.p.	25	July 28	128	5.45	Sept. 9	28
DDT w.p.	10	Aug. 2	28	2.50	Sept. 10	9
DDT w.p.	5	Aug. 9	56	3.01	Sept. 10	21
Chlordane w.p.	2.5	July 29	14[2]	0.00		
BHC w.p.	1 gamma	July 30	29	2.47	Sept. 10	0
Sulfur	500	Aug. 10	96		Sept. 10	24
Control[3]		July 29	26		Sept. 9	12

Analyzing the transformed values, F ratio of variance among to variance within insecticides (5 and 17 D.F. respectively) = 13.512, significant at the 1 percent level.

5 percent L.S.D. = 1.646 $\sqrt{\frac{}{4}}$ for insecticide means of

1 percent L.S.D. = 2.261 $\sqrt{\frac{}{4}}$ 4 transformed variates

[1]Mean of 4 transformed values where the transformation is the square root of the number of grubs found—mean for DDT 5 lbs./acre is mean of 3 transformed values.

[2]Grubs were small, brownish, a few were able to move their legs feebly. Since grubs poisoned by chlordane have a brownish cast just before and some time after death, the grubs were considered as dead and were not replaced in the cages. Hence the transformation value is given as zero.

[3]Not included in analysis since fewer adults were placed in these cages. Only one cage was used for control.

TABLE 4.—SOIL FUMIGANT TRIALS IN CAGES AGAINST FIRST INSTAR WHITE GRUBS EXPOSED ONE WEEK AT GRIFFITH STATE NURSERY IN 1947-48

Insecticide	Dosage gals. per acre	Mode of application	Survival percent	Mean of transformed values[1]
HET[2]	11.6	Injected 6″ apart	60.0	1.8026
DD[2]	47.8	Injected 10″ apart	0.0	0.3176
DD	23.0	Water sprinkled	67.5	1.9352
Carbon bisulfide	54.5	Injected 6″ apart	50.0	1.5730
Dichlorethyl ether	91.6	Water sprinkled	52.5	1.6288
Stoddard solvent	109.0	Injected 6″ apart	45.0	1.4397
Turpentine	109.0	Injected 6″ apart	42.5	1.4176
Dowfume W-10	20.0	Injected 6″ apart	0.0	0.3176
Dowfume G	99.0	Injected 10″ apart	0.0	0.3176
Control[3]			10,90,90	1.8799

Analyzing the transformed values, F ratio of variance among to variance within insecticides (6 and 21 D.F. respectively) = 9.419, significant at the 1 percent level.

5 percent L.S.D. = 0.6209 $\sqrt{\frac{}{4}}$ for insecticides means of 4 transformed

1 percent L.S.D. = 0.8451 $\sqrt{\frac{}{4}}$ variates based on N = 10

[1]See Footnote 1 Table 1.

[2]Not included in analysis—trials were performed in 1947.

[3]Not included in analysis—replicated only three times.

at 12 lbs. chlordane per acre on July 21, apparently stopped the feeding of the grubs and practically no injury occurred. While the population was reduced greatly, numerous grubs were still present on September 10.

In a third area, containing 2-1 Norway pine, it was noticed that some trees were fading and examination showed considerable root injury. Sampling gave an average population of 0.5 grubs per square foot and on July 31 chlordane was applied at 11.8 lbs. per acre. The damage continued, however, and large numbers of trees were lost. Here, as in the second area, the grubs were nearly all *tristis*.

It is evident that the treatments had different effects. The authors believe that the differences are due primarily to differences in age of grubs and time of application. In the first case a great share of the damage had apparently been done before the insecticide was applied and the grubs, excepting *tristis*, were older. In the second case the application was made before heavy feeding started and the insecticide apparently afforded the necessary protection. In the third case, involving the same species as the second but with a smaller grub population, the material was applied 10 days later and the grubs had either done their damage or continued to feed.

6. Discussion of results of the application of insecticides for white grub control

From the information now at hand, it is evident that timing of application is important. The insecticide should be in the ground by the time eggs are laid in order to prevent establishment of the grubs which are evidently most sensitive to toxicants shortly after hatching. To date it does not seem feasible to wait until damage begins to appear and then treat successfully. Treatment should be preventive rather than curative.

From the evidence obtained in the cages, mixing the insecticide with the soil is more effective than application from above in the form of emulsions, solutions or sprays containing wettable powders. Field applications also seem to confirm this.

Soil fumigants would be of value primarily when the ground is being worked and a heavy grub population is present. The fumigants will not prevent egg deposition among established stands and damage may occur before the trees are normally lifted. (This objection to reliance upon soil fumigants for grub control applies also to mechanical killing of grubs with the rototiller.)

At present, the use of chlordane in nurseries seems more desirable than the use of benzene hexachloride as Wilson and Choudhri[7] have shown the latter to be injurious to certain legumes, including soybeans, which are often used as a cover crop. Furthermore, the authors have evidence that benzene hexachloride at 1 lb. gamma isomer per acre will, in Plainfield sand in the greenhouse, cause a percentage of seedlings to die through abnormal root development. The meristematic tissue at the root tip

[7]Wilson, J. K. and Choudhri, R. S. The effect of benzene hexachloride on soil organisms. Jour. Agr. Res. 77:25-32. 1948.

is destroyed and a club root develops instead of the normal type. This is accompanied by twisting of the stem and browning of the cotyledons or primary needles from the tip toward the base.

The studies are still in progress and while detailed results for 1949 are not included, the information obtained confirms that of the years preceeding. Both chlordane and BHC applied as a dust worked into the soil remain effective for at least three seasons under Wisconsin conditions and prevent the establishment of grubs. Aldrin and dieldrin, which have been tested only one year, also appear to offer considerable promise.

At present 10 percent chlordane dust is being applied to areas in the Wisconsin State forest tree nurseries at the rate of 10 lbs. chlordane per acre as the ground becomes free of trees. The dust is applied with a power row-crop duster to the bare ground and then worked thoroughly into the soil with a disc or rototiller to a depth of approximately 8 inches. The cost for materials (delivered) is about $15 per acre.

Areas in 1-0 or 2-0 stock where the trees will not be lifted are receiving 5 lbs. per acre of chlordane in emulsion form through the overhead sprinkling system. The material is introduced between the intake and the pump by means of a barrel connected to the intake pipe and equipped with a valve to regulate rate of withdrawal, with the application being made as described previously. The cost of sufficient 40 percent emulsion concentrate to treat an acre is about $6.15. This type of treatment is regarded as affording only temporary protection and areas so treated will be dusted when the trees are removed.

Sections in 2-2 stock will remain untreated until after the trees are lifted.

Since the effect of soil insecticides varies with soil type and with plant variety it is suggested that those planning to control white grubs establish small plots which should be dusted and then seeded in order to test for possible phytotoxicity. Where the trees are in the ground, the emulsion should be tested over small plots containing the tree types involved before large scale applications are made.

The time for treatment will vary with the locality but should be before the flight of June beetles begins for areas dusted and not later than 10 days after the flight begins for the emulsion.

Heavily infested ground may be cleared of a grub population before planting or transplanting by the use of various soil fumigants such as D-D, Dowfume W-10, or Dowfume G if it is believed that the returns during the first season would justify the expense of material and application (approx. $70 per acre). Small scale tests should also be made with these materials to determine their effectiveness under local conditions. For continued protection the area could be treated with chlordane dust before planting.

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Principles of Land Management Planning For California National Forests

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The increase in population on the West Coast, and particularly in California, is a subject that has received wide publicity. Articles in magazines with national circulation have featured this growth in one way or another. California's population has now passed the 10 million figure and predictions of still greater increases are being freely offered and discussed in the state with mingled feelings of alarm and pride.

Along with other parts of the economy and social structure, the eighteen national forests in California are feeling the tremendous pressure generated by this expanding population. Forest officers are made aware of these pressures in countless ways. Timber species formerly labelled "inferior" are now being logged. Argument over water is no longer confined to the principal rivers but has spread to upstream sources within the forests. Highway construction and betterment yearly bring increasing numbers of recreationists to the mountains. Citizen groups present their own particular views and demands while the population increase overflows into accessible mountain areas with characteristic American disregard for order. Problems arising from intermingled private lands have multiplied, since individual and public interests are frequently at variance.

Sound decisions on forest land use are becoming increasingly difficult for the administrator. Mountain lands are not homogeneous in nature; there exists wide variation in soils, climate, topography, and cover. Policies relating to individual resources have been formulated and tested through the years; there now exists need for a unifying system which will correlate conflicting demands on the land and resources. It is the purpose of this paper to discuss briefly certain principles from which a planning system may be derived. If proved sound, the value of such principles to the land manager is obvious.

It is a characteristic of written plans that they tend toward a static condition, and maintenance of the written section becomes a chore which gives way to jobs of immediate urgency. This generalization is particularly true of plans which contain a great amount of detail. Since management must continue, on the spot administrative decisions tend to take the place of carefully thought out plans. The writer does not intend to imply that management plans will run affairs unaided, or that on-the-spot administrative decisions are not essential. The point to be made is that personal opinions and ambitions can play a large part in the direction of affairs. Again, machinery set in motion toward a given objective can often be thrown out of gear by transfer of personnel, and thereafter reversed by successors. One result of this situation is confusion in the minds of forest users, often followed by suspicion and distrust.

Typically, plans for resource management have been made by specialists in particular fields of resource management. In such plans recognition of the claims of other land uses often appear to have been treated as an afterthought. Where occasional overall plans have been prepared they have been blocked by lack of land control or have been of the "study" type which ignores the dynamics of administration or changing public demands.

It is necessary at this point to examine certain terms or conceptions which frequently create confusion in discussions of our subject. For example, the terms "land management" and "resource management" are frequently used interchangeably by forest officers. In a practical way, the two are closely related and interdependent; however, there is an important basic distinction. Without attempting definitions, it is possible to distinguish between the two by setting out responsibilities or tendencies. The land manager determines the purpose for which a given land unit will be managed, the resource manager suggests means for attaining objectives. The former sets priorities, the latter develops techniques. Land management tends to be long-term with fairly stable objectives, resource management may shift with development of new techniques.

Bases for Land Management Plans

A land management plan, as considered here, is a series of correlated policy statements or directives which relate to a particular "land planning unit" within a national forest. For undeveloped areas the plan should seek to forestall or minimize anticipated conflicts arising from varied demands on land or resources; in partially developed areas the plan should provide direction for resolving conflicts either existing or anticipated. For areas that have gone the full cycle from nonuse because of no demand to nonuse because of critical watershed needs the problem has became one of protection. In the latter case, the land plan will be correspondingly simple, although protection plans may be very detailed and complete. In theory, land management plans should precede resource management plans; however, few forests are without commitments in resource fields and these must be given due regard in preparation of the overall plan.

In preparation of overall land management plans several bases exist for policy determination.

1. *Commercial basis.*—This approach would base allowable use on revenues to be derived, and the best management would be one which could show high or increasing financial return. The highest use for a given tract of land would be judged on the basis of anticipated direct income. The ideal

would have been achieved when the forests were being operated on a "business-like" basis, that is, operation would show the highest possible profit.

First glance reaction is that this approach is most sensible, and, indeed, private lands could not long be managed on any other basis. However, for the national forests, and without denying the desirability of revenue, further consideration discloses weaknesses of this ideal when related to intangible or long-term public benefits.

2. *Cover type basis.*—A second approach is to authorize use on the basis of existing major resource types. Forage would be allotted for livestock grazing, timber for lumbering, and alpine territory for recreation. Water and wildlife would probably be considered by-products under jurisdiction of the state.

Weaknesses of this conception arise from the fact that human occupancy and use of the forests tend to cut across all types. Also some slopes or soils do not permit cover harvest without soil loss, and finally, manipulation of the cover has a profound effect on both water runoff and wildlife.

3. *Multiple use.*—The theory of "multiple use" is probably the most widely accepted basis for land management policy. It is a handy concept and is readily explainable to laymen who have no immediate personal interests at stake in national forest administration.

There is such a thing as multiple use, but in application the writer believes it will function safely *for a particular area* only where (1) all uses are light or are relatively non-conflicting, or (2) secondary uses are recognizable and can be withdrawn when necessary without serious disruption or injustice. The difficulty with the concept is that it is too broad and inclusive for local application. Undoubtedly multiple use is applicable as a guide over areas as large as any of California's national forests, but generalizations can be misleading in planning for land use unit by unit.

Someone has suggested as an alternative phrase, "multiple management," which term has much to recommend it when applied to the Forest Service concept of administration.

4. *Priority scale.*—It is the belief of the writer that no one of the preceding bases furnishes a satisfactory guide in preparation of land management plans for California forests. Keeping in mind that the type of plan proposed should anticipate or resolve conflicts arising from overall demand, it would seem that soundest guides could be derived from study of the collective experience of the region in problem areas.

Because of population pressure on the four southern California forests, conflicts between the various demands on national forest lands and resources have taken place over considerable areas in that part of the state. For the same reason conflicts between such demands have tended to mature earlier there than elsewhere in the region. The following highlights are presented as an aid in determining trends on the four southern forests in the belief that results will have application elsewhere.

a. *Forage.* In the case of grazing, permitted numbers of cattle dropped from 21,750 head of cattle in 1909, to 8,800 in 1946. Sheep permits, never numerous, have disappeared. In addition the trend has been toward generally shorter seasons. Land values have risen due to recreation demands, to the point that many high parks or meadows have been taken over by recreation or occupancy type of use.

b. *Wildlife.* The earliest closures against hunting were on the Angeles and San Bernardino forests, and the Trabuco district of the Cleveland, in the early 1920's. Although nominally "refuges" the closures were at least partially sponsored by water users as a means of cutting down use of the inflammable watersheds. More general closures took place during the recent war, which aroused considerable protest among sportsmen of Ventura, San Luis Obispo, and Santa Barbara counties (Los Padres National Forest). The Los Padres is generally farther from the population centers than the other three forests. Compromises on this conflict have been worked out or are still under consideration. Competition for forage between domestic livestock and wildlife led to closure against the former about 1930 in the Mt. San Jacinto-Tahquitz Valley area.

c. *Timber. Forest Survey Release No. 4* of the California Forest and Range Experiment Station summarized the forest area and timber volumes by counties. This report sets the total volume in public ownership in the four southern forests at 1,166,000,000 board feet. (Kern County is omitted from these figures, since most or all of the timber in that county is within the Sequoia National Forest). The San Bernardino National Forest contains the largest volume for a single forest, about 475,000,000 feet. The recreation policy statements for the four forests, developed between 1926 and 1940, subordinate commercial timber cutting to recreation or watershed protection. This policy is supported by public opinion in the area.

d. *Recreation.* Occupancy and use of the four forests by recreationists have been intense. Perhaps forests in other regions have been subjected to equally intensive recreation use, but certainly not others in California. Volume of

TABLE 1. NUMBER OF VISITORS[1] BY PERIODS ON FOUR NATIONAL FORESTS IN CALIFORNIA

Forest	1925	1930	1935	1940	1946
Angeles	777,393	916,608	1,519,257	994,055	671,980
Cleveland	43,717	60,986	176,400	280,000	371,010
Los Padres	54,904	94,609	109,450	243,985	126,630
San Bernardino	524,300	675,100	707,560	834,300	1,104,370
Totals	1,400,314	1,747,303	2,512,667	2,352,340	2,273,990

[1] Exclusive of through travel.

recreational use and trends are shown by 5-year intervals in Table 1.

The ratio of visits to total public acreage is about one visitor to 11$_2$ acres, based on 1946 use. Only a relatively small portion of the entire area is "usable" hence the result is terrific concentration in some areas. It is interesting to note that the peak load has shifted from the Angeles to the San Bernardino. Detailed analysis would be necessary to determine all the reasons for this shift, but no doubt fire closures are partially responsible. The San Bernardino has a relatively larged usable (timbered) area than either the Angeles or Cleveland, and is more accessible than the Los Padres.

e. *Water*. Population for the eight counties in which the four forests are located was about 5,500,000 in 1948. Population is still on the increase and water has become an increasingly critical factor. Local supplies are being developed to the utmost and Los Angeles is reaching out great distances to tap other sources. The need to protect vital watersheds from fire is almost universally recognized and large areas have been closed to recreation as well as other uses. Special legislation has also been enacted against mining in several instances. Certain summer home tracts, formerly laid out and justified by the multiple use concept, have been headaches to administrators faced with the problem of cancelling special use permits. Riverside, San Diego, and Angeles counties permit diversion of their share in national forest receipts for the purchase of private lands within the counties for watershed protection. Water companies have supported federal acquisition of watershed lands, and in one instance, at least, opposed a land for land exchange where the selected federal lands were desired for private recreation development.

Certain conclusions may be drawn from the foregoing review of trends. It is noted that demand, as reflected in use, is a dynamic affair. Also, as population increases and conflicts develop, public demands on national forest land tend to emphasize some values at the expense of others. This shift in values undoubtedly takes place within each resource field as well; however, this paper is concerned only with the problem of relative values between the resource fields. The relative emphasis thus disclosed may be expressed in the following scale of values, in descending order of priority: (1) Water; (2) Recreation and occupancy; (3) Timber; (4) Wildlife; and (5) Grazing (domestic livestock).

Minerals have not been included in the scale, since this resource, on lands withdrawn from the public domain, is ordinarily subject to private exploitation under loose control. Priority of water over minerals has been established by legislation in some instances, such as in power or reclamation withdrawals. Additional legislation is needed to clarify the position of minerals with respect to recreation and timber.

There is little that is new or startling in the proposed scale and most administrators would probably agree with it in theory. The problem becomes one of keeping the scale in the forefront of planning.

The priority scale, in effect, summarizes many of the factors affecting use of national forests in the state. In its application to the land use planning system, there is presupposed a progression toward higher uses, with modifications or elimination of uses lower in the scale. In other words, the scale permits recognition of shifting public demand.

It is apparent that use will depend on the nature of the existing resources. In some localities one or more resources may be lacking, so that demand will not necessarily proceed through each step of the ladder. One such example is the flat sagebrush lands within the Modoc National Forest, where timber is lacking. In areas where uses now exist, application of the priority system would not mean that the management plan will immediately call for elimination of one use in favor of another. In undeveloped areas the system would not preclude development. However, to avoid future difficulties, safeguards would be incorporated in the plan, permitting evolution to a higher use when and where necessary.

The Planning Period

Along with the concept of a dynamic land use pattern goes the need for recognition of a time period. From the physical factors of topography, cover, and accessibility, an idea can be gained of probable long term or dominant use. However, the administrator must have a more satisfactory guide in point of time during which established policies are valid. For this purpose the "planning period" is proposed. The principle of planning for a reasonably definite period has long been recognized as a common sense approach in formulation of resource plans. There remains only to transfer this idea to the field of land management planning.

The planning period may be defined as the period of years ahead during which trends in public demands can reasonably be forecast for the land unit in question. The period, if arbitrarily assigned, may be rounded off to 5, 10, or 15 years, as facts warrant. In many instances planning periods will be established by reference to programs of other agencies, by contracts with timber operators, or by special use permits.

In planning units, it may be found that planning periods vary by resources. If action programs are tied to policy statements, as they frequently will be in the plan, the result might be need for partial plan revision in some resource fields while the plan is still valid in others. In setting planning periods for the various resources it would seem desirable that expiration dates come as nearly together as practicable.

Both supply and demand affect the time element. In order that the planning periods be realistic, it is essential that resources inventory data be considered against past

and present public demands on the resources in question. Normally, some trend in use is discernible although occasionally it may take some spadework to uncover it. Analysis of trends may not entirely eliminate the need for a crystal ball but should be of help in reducing the need.

The Land Planning Unit

Forest officers are accustomed to thinking in terms of resources management units such as a working circle for timber, watershed for water, or a range allotment for forage. Since these units seldom have common boundaries, they do not necessarily make suitable land units for the type of planning visualized in this paper.

A land planning unit is a new management "species" and definition is probably easier on the ground than on paper. The following is offered as a preliminary definition:

> A land planning unit may be defined as the area within which administrative problems involving resources and land occupancy are inter-related and within which unit conflicts of use may ordinarily be resolved.

The boundaries of a land planning unit will probably be discernible only after some study on the ground. Some preliminary work which has been done in this field indicates that timber when present will be the core of the problem. It is doubtful whether the unit will conform to ranger district boundaries; more likely, the average district will contain two or more planning units.

Summary

Land management planning is considered to be a correlative function, which aims at minimizing or eliminating conflicts arising from varying public demands on intermingled resources. Land management plans establish a framework of policies and directives within which resources management plans must conform. Soil stabilization, although essentially a part of land management, is not discussed since responsibility is considered to rest primarily on managers of the cover.

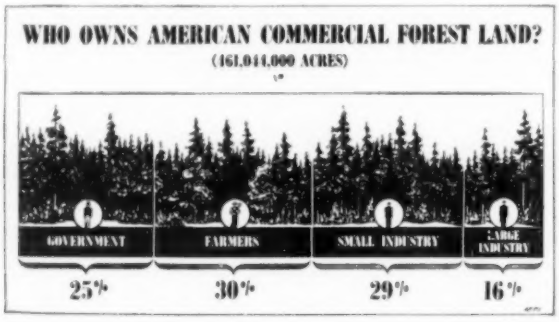
Correlated policies and directives are established on the basis of a priority scale. The scale in turn is based on past experience in problem areas where public demands have created conflicts requiring decision as to relative merits.

Policies and directives are expected to remain valid for a time lapse labelled the planning period. This period is forecast on the basis of inventories and trends in public demand on land and resources within the planning unit.

The land management unit is a new concept in administration of national forests in California. It is a composite of individual resource management units. The unit is tentatively defined as the area within which administrative problems involving resources and land occupancy are interrelated and within which unit conflicts of use may ordinarily be resolved. A land management unit will seldom correspond to a resource management unit such as a working circle, watershed, or grazing allotment.

In the final analysis, policies governing use of national forest lands will survive only if backed by a majority of public opinion. It is the function of the public land manager to anticipate crystallization of such opinion. Premature decisions may merely call for the wrath of minority groups without, at the same time, securing general public support. Biased decisions often hinder rather than assist in the search for satisfactory adjustment of conflicts.

It will be noted that, as use rises in the proposed scale of values, users or dependents increase in number. The final result is a broadening base of dependents upon the forests; multiple use gives way to the greatest good to the greatest number in the long run.



The Rio Grande Valley in New Mexico—Its Present and Future[1]

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IN THE RIO GRANDE Valley in New Mexico there is being fought a battle which will determine whether or how civilization, on its present scale, may long survive in the arid southwestern United States. I do not refer to the harnessing of atomic energy being developed at Los Alamos and Sandia laboratories in this valley which, on the one hand, may be used to bring great good to mankind or, on the other hand, if destructively used may threaten man's very existence on this earth. I refer to the battle that man is fighting with himself, to determine whether he can learn to live harmoniously with the inexorable laws of nature that are involved in the relationship between man's use of land and his need for water. True, man is not dependent upon water alone in this region; it has many other natural resources and opportunities upon which he can build an economy. However, water supply and its control is a key element in practically the entire present and future economic structure of the Southwest.

Scarcely a day, and never a week, goes by without reference in the local press to some matter relating to water. Beginning in February last year and continuing through most of June, the people of the Middle Rio Grande Valley were constantly alerted to the danger of a spring flood. Yet the winter snow packed in the high watersheds was not so great as in former years of record. The danger arose not so much from the possibilities of a peak runoff somewhat higher than average, but from the fact that the highly perched bed of the river has continued to aggrade to a point that the channel between the flood levees will no longer carry the flow for which they were originally designed and completed 14 years ago. Representatives of the Corps of Engineers testified before the Senate Committee on Public Works in January 1950 that in places the bed of the Rio Grande has been building up at the rate of 3 to 5 inches per year in recent years. In places it is 7 feet above the adjacent land. A breach in the levee now could spell disaster to thousands of people.

Of equal or even greater significance are the frequent and continual references in the press to the impending inadequacies of water supply for irrigation and for expending municipal and industrial needs. We read about the water debt that the Middle Valley owes to Texas, below Elephant Butte Dam, and about fears of the day when that debt under the three-state compact will be so great that irrigation will have to be drastically curtailed. A proposal of the Atomic Energy Commission to provide additional water for Los Alamos meets with the vigorous opposition of the Pueblo Indians because it may take away water upon which the Indian settlements are dependent. The Albuquerque Chamber of Commerce appoints a committee to study the problems incident to the use of New Mexico's share of San Juan River water, including a diversion through the Continental Divide into the Rio Grande Valley. A snowfall somewhat less than average to date in the upper watersheds stirs threats of a water shortage during the 1950 irrigation season.

Water Problems Not New

Looking back in the available records we find some equally impressive reports on water problems. When hostile Indians had been subjugated soon after the Civil War, settlement which had been confined to the main valley expanded to the tributary valleys of the Rio Puerco, the Galisteo, and other side streams. Until about 1875 irrigated areas existed along the Rio Puerco from a point west of Albuquerque to the head waters. Irrigated holdings were small and were watered from small diversions in the discontinuous channel. As a result of a new deep gully forming from the mouth headward, Los Cerros 34 miles upstream was abandoned about 1888. San Ignacio and San Francisco, 62 and 73 miles respectively from the mouth, were virtually abondoned by 1896. Casa Salazar was abandoned in the late 1920's and there now remain only two relatively small irrigated communities in the headwaters of the stream that have been able, by great effort, to retain their diversion dams. The development and abandonment of land on the Galisteo and smaller tributaries have occurred in a similar manner.

Development along the main stream in the Middle Valley was established long before the American occupation. Irrigation increased with the increasing population following the established pattern of small villages and small irrigated tracts. Maximum development was reached in 1880 when, it is reported, 124,800 acres were developed within the Middle Rio Grande Valley. For the next 40 years the general trend was downward. The increasing upstream depletion, unstable river, increasing sediment, floods, and waterlogging of lands forced acreage out of production.

During the early part of the present century unsuccessful efforts were made to secure a program of rehabilitation for the area. By 1925 the acres under development had shrunk to 40,000. Continued deterioration of the valley lands finally caused community action that resulted in the formation of the Middle Rio Grande Conservancy District in 1925. The district has been fully in operation since about 1936. By 1947 the area under development had increased to 118,000 acres of which 79,700 acres were actually irrigated. The conservancy district has been fully

[1] Presented at a meeting of the Southwestern Section, Society of American Foresters, Santa Fe, New Mex. Feb. 24, 1950.

in operation since about 1936, but its works and the operation thereof have not solved the problems incident to the rising river bed throughout the valley.

Elephant Butte Reservoir, which supplies water for one of the most successful irrigation projects in the United States, was completed so that storage of water began January 6, 1915. This reservoir eliminated the danger of major floods and gave assurance of a stable water supply for 156,000 acres of highly productive irrigated land in New Mexico and Texas. The people of that area, however, remain complacent about the fact that during the first 32 years of the life of the reservoir it has been one-sixth filled with sediment. Until about 1935 the original capacity of 2,634,800 acre-feet was filling with sediment at the rate of 18,276 acre-feet a year. Surveys made in 1935 and 1940 indicate a reduction in the earlier rate to an average annual inflow of sediment of about 10,000 acre-feet. This reduction is due to much of the silt being dropped on the delta that has been formed at the head of the reservoir and which is now covered with a dense growth of tamarisk (salt cedar). A much larger quantity of sediment would otherwise continue to be carried into the reservoir. A proposed project to excavate a channel through the delta from the head of Elephant Butte upstream to the Bosque del Apache Wildlife Refuge in order to reduce stream bed aggradation and waterlogging further upstream when completed will again increase the rate of deposition in the reservoir.

Consumptive Use of Water Supply

Next, let us consider the consumptive use of water supply which now enters the middle Rio Grande Valley, and its relation to the present and future of that valley. The Bureau of Reclamation, according to its 1947 report, estimated that the consumptive use of the water between Cochiti and San Marcial was averaging about 536,000 acre-feet a year under 1936 water table conditions and present irrigation development. That quantity of water is evaporated and transpired from the irrigated lands, bosque lands, idle lands, river bed, canals and open water, wetted sands and bars, roads and rights-of-way, or consumed by cities, towns, etc. Of particular interest are the so called bosque lands. During the last two decades, especially, abandoned waterlogged lands, other areas along the river, and the Elephant Butte Reservoir delta have become overgrown with a dense stem of tamarisk and other riparian vegetation. The Bureau of Reclamation survey indicated that in 1947 or shortly before, there were some 60,640 acres of such lands which were consuming water at the rate of almost 4 acre-feet an acre for a total use of 238,700 acre-feet a year. In other words, approximately 45 percent of total consumptive use in the valley was being made by these largely waste areas. The established stands of bosque growth are thickening and each year a few more acres of irrigated land are being abandoned in the valley due to the waterlogging caused by seepage from the perched river bed, the increased difficulty of drainage, and the further enlargement of the stream delta. It is highly significant that only 1.8 acre-feet of water is actually consumed each year in growing an acre of irrigated crops, whereas each surface acre of bosque land consumes an average of approximately 4 acre-feet of water.

It is to be noted, therefore, that a sort of chain reaction is taking place. The sediment that originates on the watershed is being transported into the main channel of the river. The resultant aggrading of the river bed is the major cause of the increase in flood danger. Seepage from the perched river channel is decreasing stream flow and by waterlogging is reducing irrigated acreage. The waterlogging, in turn, further increases the loss of water through consumptive use by waste vegetation. The area of wasteful vegetation is further increased through the enlargement of the delta by the deposition of the silt that is being carried down the river. The proposed works to restore the transportation of the sediment into Elephant Butte Reservoir will shorten its storage life and threaten the future of the valley below Elephant Butte Dam.

For the present at least, this situation continues to worsen and portends for the settlements in the valley the same kind of disaster that befell the ancient city of Ur of Chaldea, the home of Abraham. The Bible tells us that the city of Ur had a curse upon it and would eventually be destroyed, as it was. The curse supposely was placed upon the city because of the wickedness of its people. Perhaps that wickedness was the failure of the people to conserve the forest, grazing, and soil resources on the watersheds of the Tigris and Euphrates Rivers above the city.

Three-Point Solution

The solution of the problem, in order that the Rio Grande Valley may have a brighter future, may be likened to a three-legged stool. One leg of the stool consists of flood control on the main stream now being initiated by the Corps of Engineers. The second leg is channel rectification, rehabilitation of drainage and irrigation systems, and the reduction or control in so far as possible of the waterfall water-consuming vegetation that is invading the valley, as is proposed by the Bureau of Reclamation. The third leg is the control of erosion and retardation of runoff on the watershed. The first and second legs of the stool depend, in the long run, upon the third leg or program for erosion control and runoff retardation on the watershed. The Corps of Engineers' program as now envisioned consists of the construction of the Chamita and Jemez Dams to control the floods from the Chama and Jemez tributaries, and raising and strengthening the levees. The two flood control reservoirs that the Corps of Engineers would construct include provision for storage of the sediment that would be brought down these tributaries during the first 50 years after con-

struction. Of particular significance is the fact that the bulk of the sediment being deposited in the valley comes from the Rio Puerco, the Salado, the Galisteo, and other tributaries for which no dams are contemplated. The Jemez and Chamita reservoirs provide sediment storage for only 50 years, and 50 years is but a short period of time in the history of a region. Meanwhile, the program for the third leg of the stool languishes.

Volumes have been written and files of the interested federal agencies are filled with reports on the serious depletion of plant cover and accelerated erosion that has taken place on the watershed of the Rio Grande Valley in New Mexico. I recognize that there are differences of opinion among the experts, particularly with reference to how much of the erosion might be called natural erosion, and that which is accelerated erosion induced by man and his activities. Actually, that argument is largely beside the point. What man must do if civilization is to survive on its present or a larger scale in the Rio Grande Valley is to put into effect as soon as possible a land management, erosion control, and runoff retardation program that within reasonable limits will retain the soil in place where it can continue to produce a sustained yield of forage, forests, and other related products and uses and keep it from being carried into the river. Unfortunately, while there is much talk about undertaking such a program, far too little is being done about it. The watersheds within the national forests at the higher limits of the watershed which have been under management for nearly half a century are perhaps in the best condition, but are still not yet fully effective. In the lower limits, where most of the erosion is taking place and most of the sediment is originating, far too little is being done.

Owing to the mixed character of the land ownership and distribution among several federal agencies, the state, and private ownership, only an integrated over-all program can be expected to do a complete job. No machinery has been developed to provide that over-all integrated approach. It is expected that the program being investigated by the Department of Agriculture for upstream flood control under the provisions of the Flood Control Act of 1936, will propose such an integrated over-all program. It is extremely unfortunate that in this critical area the investigation begun before World War II has not yet been completed.

Another unfortunate circumstance is that despite the fact that the lower lands in the arid Southwest are among the most serious contributors of sediment to streams anywhere in the United States, a comprehensive organized research program has never been undertaken to develop the solution to the many unsolved phases of the problems that are confronted in accomplishing an effective erosion control and runoff retardation under the conditions that prevail in this area.

The Rio Grande Valley has many other resources, including timber, minerals, range forage, wildlife habitat, and recreational sites, which can form the basis for much of the industrial development that is needed if the valley is to take care of its population increase in future years. However, the development of these resources as well as the maintenance of the present basic agricultural industry all depend to a greater or less degree upon a sustained water supply, free from the danger of floods. The future development and maintenance of the economy of the region depend upon the sound integrated development of all these resources. We can no longer consider each element of the economy in a compartment or vacuum by itself.

The situation in the Middle Rio Grande is only symptomatic of the problems confronted throughout the arid Southwest. However, the most aggravated situation where man has already sought to make most complete use of the water resources and at the same time has failed to exercise care in the use of the watersheds in the Southwest, occurs in the Rio Grande Valley. Here is the place to determine how economic survival can be achieved. Here is where to fight the battle that must be won if civilization, on its present scale in the arid Southwest, is to survive in the long run, or if it is gradually to be overtaken by the same curse that befell the ancient city of Ur.

Notes

Use of Aerial Photos in Management Plans[1]

Highly specialized services in aerial photography and photogrammetry as related to forestry are vailable to timberland owners today, although some persons believe that only the techniques of regional surveys can be applied to their particular holdings. We have planned new infra-red aerial photographic surveys for ten operating timberland companies in the South. These total some 12 million acres of gross coverage and represent approximately 2 million acres in fee lands.

It is interesting to note the approximate ratio of fee lands to gross area flown is 6 to 1. The scattered ownership of most private companies seldom shows a near equal between fee lands and gross acreage flown. There is always excess, thus increasing cost. Some operating companies actively engaged in timber purchases and land acquisition find this combined territorial coverage most advantageous and do not consider this increased cost as part of the regular timber survey but rather an additional product received. They find uses for this additional coverage in several ways:

1. The location of good operating sawtimber stands extensive areas of pole potentialities, and pulpwood stands are readily obtained from the photographs. This affords concentrated efforts by buyer and dealer to spend time on purchases of excellent timber rather than consuming considerable time just hunting down tracts. This factor can be very important in competitive buying.

2. The same situation exists with land purchases. There are many tracts available for possible purchase. With aerial photographs many undesirable tracts may be eliminated and those showing possibilities may be more thoroughly investigated on the ground. This factor can account for many man days savings in an active land acquisition program.

Each of these factors may exact considerable savings over a period of years, thus completely discounting the additional investment. We have had two clients express themselves strongly on this subject after using their territorial coverage for only two years. It must be pointed out, however, that the photographs are dated from a certain year, month, day, and hour. As time passes and a territory is active, more and more tracts will have to be checked on the ground for changes since the photographs were flown. This factor places limitations on new photography, but especially on existing AAA photography, which was flown principally between 1938 and 1942.

In the photograph we have all the timber stands, roads, fields, streams, culture, relief, and all habitation recorded for study, and this medium establishes forever the condition existing as of that date. Several years ago we compared a renewal flight for a company after a period of 10 years. The interpretation of the area offered astounding results as to past management practices and policies. This point cannot be overlooked in planning operations for the future. The photographs permanently record the land features long after human memory has lapsed and personnel have vanished.

The correct interpretation or reading of the photograph is basic and most essential. The interpretation is necessary to formulate plans for cruising, to map all timber stands, to set up the various plans for management, and to analyze operating areas. Pre-interpretation creates the basis for ground checking and when skillfully planned ties together areas, volumes, and growth more closely than we have ever been able to bring them together by straight ground cruising. Actually there is no conflict between mechanical cruising or randomized ground sampling, nor is it a question of one method against another. It is believed, however, that aerial photographs used with ground sampling can produce a much closer bond between the factors deemed so important for management decisions.

A line map or a photographic mosaic may represent the basis for recording all the information interpreted from the photographs. Thus, the landowner has for permanent record the evaluated classification of timber stands and operating units for immediate use in formulating plans for woods operations.

A detailed cruise sheet plus growth data showing tree sizes and volumes for each species and tied into the various timberland areas adds information essential for management. Such questions as cutting budgets, operating areas, log averages, organization efficiency, and depletion records all can be answered by the combined efforts of ground checks and photographic interpretation. These are some of the services some private firms can and are qualified to render timberland owners in the South.

One of the prerequisites in developing an aerial timber survey is to use properly designed aerial photographs. In this instance, I refer particularly to infra-red photography flown specifically for a landowner. I believe that infra-red film produces for our southern forests, under most conditions, the best possible photography to interpret.

We recognize there are many varieties of infra-red and that no one filter, season, or time of day can produce satisfactory photographs for all timbered regions. We recognize and have recommended use of several different filters (other than the minus blue) for various timberlands during various seasons and time of day. These variations have proved successful for the particular area and operation intended. We have had

[1] Presented at a meeting of the Forestry Section, Association of Southern Agricultural Workers, Biloxi, Miss. Feb. 9, 1950.

aerial experience in southern timbered areas ranging from the Atlantic seaboard to Texas. It is important to remember that a standard for one job may not suffice for another; for this reason the photographs and the interpretation techniques must be interchanged to fit each particular area and the practical requirements of the landowner. Ignoring these factors can lead to delivering a very limited and impractical package.

Setting the technical forestry requirements for a good photographic job is only one phase of the planning. If the flying is not properly executed and the prints are poorly developed, you may possibly end up with photographs very definitely limited before the interpretation values can be analyzed. Certain specifications are very necessary in the proper execution of a flight. I have found that there is a limit, however, to the amount of specifying one can do before he finds himself increasing the cost of his job. This is done by demanding certain undefinable and academic specifications which often require the contractor to increase his flying hours, laboratory, and material cost.

There are many uses for aerial photographs obtainable from government sources. There is, however, one major factor to be recognized when these photographs are used by private concerns. The public surveys were designed to fit general public needs—land use, sanitation, highway, agriculture, etc. They cannot be expected to fit all the needs of a private timber landowner.

We use these photographs in conjunction with our straight ground cruising, particularly to delineate open from timbered areas. This limited use improves our efficiency in straight ground cruising.

My efforts in this field have been principally toward developing proper timber photography, practical cruising techniques, and workable systems for organizing this vast amount of data for carrying out an active timber management program for private concerns.

The requirements of private forestry management vary considerably according to locations, logging conditions, mill capacities, organization, present condition of timberlands; and finally and most important is the question: Can the owner use this detailed information to his advantage? Any system, technique, or material delivered to a company which is theoretical or academic and cannot be used freely by the company organization is of little value. The data *must* be delivered in a form that can readily be transcribed into daily operations, thus bringing the woods into the office of management. This cannot be accomplished by accepting national photographic specifications and standard interpretation techniques.

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Protecting Direct Seedings in Rodent-Infested Areas

Direct seeding is generally conceded to be more satisfactory than the planting out of nursery stock. The seedlings form a better root system with long roots which penetrate the soil deeply and enable the plants to stand drought. Also, seedlings are less subject to disease. In this area at least, they have outstripped year-old nursery stock in a period of 6 months.

The cost of direct seeding is much less than that of planting; about half, according to the estimate published by W. E. McQuilken[1]. And, as he has pointed out, it does not depend on the maintenance of a nursery and the starting of stock one to four years in advance.

However, direct seeding in the west has usually failed. The chief cause is destruction by rodents. Birds also eat some of the seeds, and the young seedlings are killed by high surface soil temperatures and drought.

To overcome these difficulties, various measures have been taken, such as poisoning rodents and protecting the seed by hardware-cloth covers or wire screens. Poisoning is perhaps the most successful means, but it involves risk to livestock and to wild animals.

Several types of cover were tried on recently constructed road slopes in the Angeles National Forest, in the hope of devising a type which would be both inexpensive and effective.

Planting tests were made with the following protective devices:

(1) Pine-needle mulches, 1" in depth
(2) Straw mulches
(3) Fiber screens
(4) Beer cans (3 seeds per can)
(5) Control; no protection.

Plantings were made as comparable as possible; the road slopes were of the same elevation and each method was tried on a slope with south exposure. Seeds were all from the same lot (*Pinus coulteri*, stratified at 35° F. for three months). There were small stands of Coulter pine in the vicinity of these slopes, although the road itself went through chaparral brush. The soil was all of the same decomposed granite.

After 5 months the following results were observed:

(1) 8 to 20 percent of the seedlings under the pine-needle mulch survived, and showed a growth of 2 to 4 inches.

(2) 20 percent of the seedlings with the straw mulch survived and had an average height of 3 inches. They were pale, yellowish, and weak, showing typical symptoms of nitrogen deficiency.

(3) 38 percent of the seedlings under fiber screens survived. They had an average height of 4½ inches, and appeared green, healthy, and vigorous.

(4) 55 to 61 percent of the seedlings under beer cans survived. Average height was 5½ inches. They were healthy and vigorous.

(5) No seedlings survived where no form of protection was used.

The same lead was maintained

[1] McQuilken, W. E. Direct seeding of trees. Yearbook of Agriculture, p. 136, 1949.

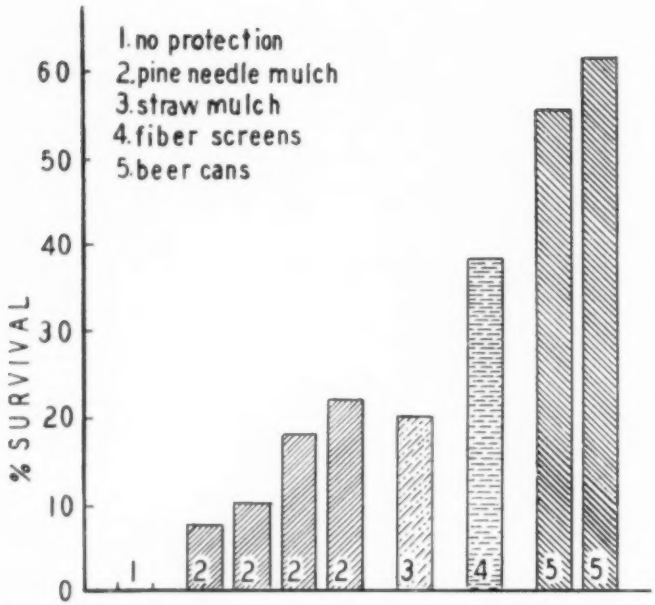

FIG. 1.—Relative effectiveness of various methods of protecting direct seedings of Coulter pine. Unprotected seeding showed no survival.

after 11 months, when another measurement was made. At this the fiber screen group averaged 5½ inches in height, and the seedlings in beer cans 7 inches.

The cans were prepared by removing the bottoms, and slicing the tops into prongs that let in the air but kept out the rodents.

It is apparent the best results were obtained from the use of the cans (Fig. 1). Since a greater survival was obtained with these than with fiber screens, which provide equally good protection from rodents, it would seem that the cans are in some additional way conducive to good growth. This possibly could be the maintenance of moisture in the soil temperatures. There was a difference of 6 to 8 degrees F. between the soil temperatures one inch below the surface inside and outside of the cans, on a moderately warm day, and about 15 degrees F. in the air temperatures. These differences probably would be somewhat greater on a hot day.

The cost of beer cans is negligible, since the road slopes of almost any highway will furnish an almost unlimited supply.

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Methods and Results of Resurvey In Checking 10-Year Prediction of Yield

The writer has held for several past decades that yields of timber can be predicted by the stand table method with a fair degree of accuracy for the next decade, and possibly a succeeding one, only if certain precautions are taken in order to correlate projected diameter growth rates with the behavior to be expected of trees growing in stands.

In stands that are composed of trees of many ages, in which the age classes cannot be mapped nor their area determined, the individual tree becomes the unit for predicting growth. Average growth in diameter for each d.b.h. class may be modified by classifying the trees according to thrift. But for straight averages as applied to second growth pines in the South, the two chief problems to be solved are mortality and the future rate of diameter growth. Lesser but still important are the factors of cull losses, or progress of defect, and cyclic changes in weather as it affects annual growth.

It is an axiom that accuracy of growth prediction cannot exceed that of the initial, and final, estimates. Since growth is but a percentage of volume, errors of estimate are magnified by the ratio which growth for the period bears to the initial error. For instance, assume that the estimated annual growth for the next-year period is at the rate of 5 percent on the initial volume, totalling 50 percent for the period. If the correct initial volume is taken as 100 units, the predicted volume at the end of 10 years will be 150 units. If the initial volume has been wrongly estimated by 10 percent, let us say, at 110 units, the predicted volume at the end of 10 years will then be 110 x 1.50 or 165 units. The difference in the predicted volumes $\frac{165 - 150}{150}$ or 10 percent is therefore the same as the original cruising error. However, let us suppose that a check cruise made at the end of 10 years shows the actual volume to be only 145 units. The error of estimate for the initially correct cruise is $\frac{150 - 145}{145}$ or + 3.45 percent, but for the incorrect cruise is $\frac{165 - 145}{145}$ or + 13.79 percent, or roughly four times as great. Similarly, supposing that the final check cruise showed only 140 units. The two errors derived in the same way would now be + 7.14 and + 17.85 percent respectively, with the second about 2 1/2 times as great as the first. The character of the final error is therefore complex, since it varies not only with the error of the original cruise but also with the error of the volume prediction.

The tendency in predicting future growth in diameter from past growth is commonly to overestimate the growth rates of the

average trees of the d.b.h. classes. When future mortality is underestimated it merely increases the error. Future mortality is diminished almost to the vanishing point in young stands by frequent (5-year) thinnings, and in older timber a short (10-year) cutting cycle will greatly reduce it, especially if the timber is marked with good judgment for each of the successive operations. Yet residual mortality will occur, and must be accounted for in any growth prediction. The standard method, outside of records kept on permanent sample plots, is to tally all trees that have died within a fixed past period of years, the period being correlated with easily recognized signs of deterioration of the crown, branches, bark, and wood of the dead trees. In the case discussed, a 2-year period was used. The tally is reduced to losses per year, and this in turn multiplied by the years in the period of prediction, with a separate calculation for each present d.b.h. class, to obtain the future stand table.

There remains the danger that the growth rate itself will be overestimated. This tendency is overcome by taking two precautions. The first has been accepted as standard practice, namely, to sample *all* the trees growing on systematically spaced plots. This overcomes the error inherent in sampling single trees at equal intervals, which selects a greater proportion of open than of close grown trees than occurs in the forest.

The second error is more serious, and the precaution consists of dividing past diameter growth into two (or more) measurements. This practice has not yet become standard. For a decade, the periods are 5 years each. Tabulation then indicates the past *change* in growth rate, which is then projected into the future decade. The percentage reduction between the two last 5-year periods is doubled to apply to the coming 10-year period. When past diameter growth is taken as indicating future growth on straight line projection, the errors for closely grown stands are always plus and may be excessive. The prediction of deceleration or acceleration is indispensable, yet it is still commonly neglected in favor of straight line projection. Objection may be made that extrapolation of curves is subject to individual judgment and hence to error. But any prediction of an event is but an approximation, and the most inaccurate of these is that which apparently introduces no guesses, namely, straight line projection. A method is best judged by its proven results.

In the third place, it is assumed that the resurvey will be conducted to the exact specifications for utilization that governed the original survey. In the case cited below, changes in the closeness of utilization made ± 14.5 percent difference in the volume of the succeeding estimate, thus requiring two standards for the expression of this final estimate.

In predicting future growth on a large area that is being continuously logged, the effect of selective cutting, or removal of the larger trees, is to stimulate the growth rate on the residual trees, thus overcoming deceleration in part. Where the initial survey is of land that has been under operation for two or more decades, this factor is accounted for in the first prediction.

In order to predict growth on an operating property on which cutting is regulated by an elastic diameter limit, it is necessary to base the calculation on an assumed average minimum diameter to which the timber will be cut. As is well known, rigid diameter limits are not applied in marking, and the sole purpose of the diameter limit calculation is to arrive at the approximate volume to be removed, and to give a practical basis for predicting growth by diameter classes. The basis of growth prediction is then the assumption that the cutting budget will remove a volume equivalent to the stand that will be present, above this minimum diameter, at the year representing one-half the period of prediction, that is, 5 years in the future for a 10-year period. *This allows for ingrowth before cutting*, in a continuous operation, and for growth that takes place before the timber is cut, equivalent to one-half the growth for the period. To this method of calculation the term *horizontal cut* has been applied.

Even with these precautions the tendency is to overestimate the future growth to some extent. Hence, for a 10-year period a safety factor of 10 percent of predicted growth was deducted. Such a procedure complies with accepted business practices, and it must be remembered that growth predictions are made as the basis of future investments, and overestimates can no more be justified in this field than in that of timber estimating itself.

Based on these principles, a recent resurvey of a large area of mixed loblolly-shortleaf pine and hardwoods in the southern coastal plain was completed in 1949 following an initial survey in 1939. The final estimate, on the identical basis of utilization, came within minus 4 percent of the predicted volume, based on a minimum average cutting limit of 20 inches d.b.h. Deceleration of pine, despite the continuous release by cutting and by removal of hardwoods, was 7.5 percent for the decade. Hardwoods on the other hand showed accelerated growth of 4.5 percent.

Without the attainment of reasonable accuracy in growth predictions, the plans for future management of large properties may contemplate either too heavy or too light a cut for the next decade, with accompanying serious losses in installation of permanent improvements and mill capacity. It behooves foresters to pursue methods of growth prediction that have been tested for accuracy by actual demonstration.

H. H. CHAPMAN.

Points of View

The Stability of Latin Names

Each year hundreds of students are set to memorizing the Latin names of plants in painful quantity. Their natural lack of enthusiasm for such business receives a standard treatment in which it is explained that only Latin names are universal and constant; common names are chaos. Of course, in making this explanation, the dendrology professor must either qualify it with so many exceptions that the original thesis begins to totter, or he must say it with an inward chuckle at the rare joke he is playing on these unsuspecting sophomores.

I thought that, when the textbooks caught up with the Forest Service's belated change from the American Code to the International Code, discrepancies in Latin names at least would be resolved. Then I could take the book and lead the neophytes out of the darkness of ignorance into an admiration for the reasonableness and unvarying nature of Latin names. Alas, I had not taken into consideration the taxonomical brethren's fine spirit of rugged individualism. *Standardized Plant Names* (5) and the Forest Service check list (7) still do not see eye to eye. Shall I teach *Pinus edulis* or *Pinus cembroides edulis*? *Pinus cembroides parryana* or *Pinus quadrifolia*? Should it be *Pinus leiophylla* or *Pinus leiophylla chihuahuana* these days? Both are advanced by good authority. Must students learn both *Pinus apacheca* and *Pinus latifolia*? Where is orthodoxy and where is schism?

Harlow (3, 4) and Dayton (2) have wrestled with this problem with urbanity and humor, but all humor leaves me each year as I revise a standard list of names for student reference. The humorous aspect of dropping *Juniperus utahensis* in favor of *Juniperus osteosperma* escapes me. The technical argument for changing *Juniperus pachyphloea* to *Juniperus deppeana* leaves me cold. It is difficult for an honest teacher to insist on the superior constancy of Latin names in a region where more forest trees are recognizable by the common names used by Michaux (6) and Belknap (1) than by the Latin names used by the same authors. It appears that soon he may have to abandon the traditional introduction to his dendrology course and admit that Latin nomenclature has become a game for specialists which has limited value to the general practitioner.

Common names offer little hope for order or constancy and no hope at all for universality. But, my taxonomic friends, merely because we of the rank and file cannot do without your Latin nomenclature is no reason to sell us an inferior bill of goods. There are some reasons for changing Latin names with which few people will quarrel, e.g., when a species has been assigned to the wrong genus, when a species is reduced to variety status, or a variety raised to species status. I have no wish to shackle taxonomic research. I am convinced, however, that most foresters do not much care whether a Latin name is the oldest one assigned to a particular species or the most appropriate one which might be coined. We should like to be confident that it will persist until a change in classification makes a different name necessary, because there are uses for our time more important than learning the changes which take place in and the variant forms of "immutable" and "universal" Latin names.

If taxonomists have a nomenclatural function, surely it is to provide all scientific workers with a stable, unambiguous system of Latin names and plants. It is not to play parlor games with them nor to indulge in hobby research for older names which might, under present rules, supplant well-known names of long standing.

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Managing Northern Hardwoods

Kernan's article[1] advocating the clear-cutting of his northern hardwood stands contains so much good sense that I hesitate to criticize it adversely. Yet the overall impression left with the reader is, in my opinion, so seriously wrong that an answer seems necessary.

Let me agree at once that there are many stands of northern, central, and Appalachian hardwoods where the best management solution is a commercial clear-cut followed by girdling or poisoning of the cull trees. These are stands so poor that they do not have a significant amount of good growing stock. My chief general point of difference with the author is his failure to distinguish between proper remedies for a specific stand and the merits of the selection method as a *system of management*. The article confuses the true purpose and use of the selection system and seems to condemn it because it may not fit all stands. The selection system can be strictly ap-

[1]Kernan, Henry S. 1950. Heavy cutting in northern hardwoods. Jour. Forestry 48:496-497.

plied only to *managed* forests or forests with at least fair stocking and an adequate diameter distribution. On even-aged or high-graded depleted stands other measures may be required before the selection system can be applied.

One of the points emphasized in the article is that satisfactory reproduction cannot be obtained with the selection system. I know from research and personal observation that adequate reproduction can be obtained by the selection system (group or single tree) if *proper stocking is maintained* and holes in the crown canopy are large enough. It is true that young trees from seedlings to poles do require partial sunlight, but not necessarily full sunlight the whole day, for successful development. This can be provided by the proper use of the selection system. The stands in question, as described in the article, seem by far too heavily stocked (present or past) for good development of advanced reproduction. This question of stocking is an important one for reproduction and for growth on the crop trees. In all-aged forests we may have to lower our sights as to what constitutes desirable stocking to perpetuate the stand and to give maximum quality growth on the crop trees.

A felled harvest tree 18 to 24 inches d.b.h. will ordinarly provide an opening large enough for reproduction to start and develop well for a number of years. In the more intolerant hardwoods group selection is often needed. The one 40-foot opening mentioned in the article is probably a poor guide of what could be obtained by a fully applied group selection method. Perhaps there is something unique about the stands in question, but excellent reproduction occurs in holes much smaller than 40 feet. I have seen it in many stands in many states.

On the economic side there are several statements that are open to question. In the first place, "cutting to mature trees 14 inches d.b.h. and over" is not the selection system (and a 14-inch tree is seldom mature). It is diameter limit cutting which is something entirely different. I agree that this system would be folly for Kernan's stands or most other stands. A crop tree will commonly increase in value 10 times or more from 14 to 20 inches d.b.h. This is the period of most rapid sawtimber value increase and cutting *crop* trees at 14-16 inches is just poor business (except on very poor sites).

It is not correct to *assume* that the selection system has higher logging costs per M than clear-cutting. Evidence is not yet conclusive, but the reverse may well be true. If a logger need take only the harvest trees of 18 to 24 inches plus a few smaller trees for stand improvement, his costs may be lower per thousand feet than if he clear-cuts all trees large and small. There is little doubt about the economic interest of the woodland owner. If the logger cuts good young sawtimber growing stock, the owner loses and loses heavily. It is only in the special case of a completely depleted uneven-aged forest with no desirable growing stock that clear-cutting hardwoods is surely the best solution.

To me the acceptance of clear-cutting northern hardwoods (or Appalachian or central) as a permanent management system for sawtimber production is an admission of professional defeat. It is the abandonment of silvicultural principles and economic goals. It is a choice of lower returns from the land to save the time and trouble of bringing the stand into a managed well-stocked condition and to avoid an effort to educate landowners and loggers that high production of quality material will benefit us all. Certainly many of our hardwoods need a very heavy *improvement* cutting which is some cases will approach clear-cutting. Most of them also need a cash outlay for girdling or poisoning. But let's not confuse the selection system of silviculture with specific needs of individual stands. On the other hand, let's use it as a flexible and useful tool, not be its slave.

LEON S. MINCKLER,
Carbondale, Illinois.

Reviews

Time, Tide and Timber—A Century of Pope & Talbot.

By Edwin T. Coman Jr. and Helen M. Gibbs. Foreword by J. Hugh Jackson. Preface by Charles L. Wheeler. 480 pp. Illus. Stanford University Press, Stanford, Calif. 1949. $5.

The California gold rush in 1849 attracted to San Francisco Andrew J. Pope and Frederic Talbot from East Machias, Maine, where their families operated sawmills and shipyards. But these young men did not join the stampede to the gold fields. Instead they laid the foundations on which to build a lumber and shipping empire in the West by opening a lumber yard on the beach and engaging in lightering cargo from the sailing ships. To supply the demand for lumber to build booming San Francisco, Pope and William Talbot, who had replaced his brother Frederic, organized the Puget Mill Company and in 1853 built a steam sawmill at Port Gamble on Puget Sound. The year 1853 was so early in western history that it witnessed the appointment of the first governor of the Territory of Washington and the celebration of the first wedding in Seattle. To market the growing production of Puget Sound mills, Pope & Talbot expanded their fleet of sailing ships to carry lumber to the Sandwich (Hawaiian) islands, Australia, and the Orient, as well as California.

Today a Pope & Talbot mill is still sawing lumber at Port Gamble, and a fleet of "P&T" ships (among them the "P&T Forester") operates to North and South American ports. Although much of the land logged by Puget Mill Company subsidiaries is now occupied by the homes of thousands of residents of suburban Seattle, Pope & Talbot today owns 137,000 acres of forest land in certified Tree Farms. Third and fourth generations of Popes and Talbots in the West are active in the management of the oldest West Coast lumber and shipping company still operating.

Time, Tide and Timber is more than the history of Pope & Talbot; it is the history of a century of the West Coast lumber industry—of recurrent booms and depressions, of cooperation in world trade promotion, and cut-throat competition, of successes and failures. It is the result of a research project conducted under the sponsorship of the Graduate School of Business of Stanford University. Fourteen pages of acknowledgments and bibliography are required to list the individuals interviewed and the published and unpublished material studied. But the resulting book is no dry academic study. Professor Coman, assistant professor of business history, and Miss Gibbs, research associate, both of Stanford University, have enlivened it by their "effort . . . to observe the company and business conditions through the eyes of men who themselves were active participants fifty and seventy-five years ago," to quote from Dean Jackson's foreword. Telling in the preface of the genesis of the book, Mr. Wheeler, executive vice president, Pope & Talbot, Inc., states: "It was also agreed that the study was to be objective, and the conclusions presented were to be based on the facts as revealed by the research." The lessons which may be learned from this history are enhanced by the disclosure of mistakes as well as achievements.

The young forester who contemplates a career in the lumber industry would be well advised to read this book. It is recommended for reference reading assignments in forest economics courses. The reference value of the book is increased by a 99-page appendix which includes data on lumber production and log and lumber prices from 1860. For the older practicing forester this book provides much food for thought, and if personally acquainted with any of the men who appear in its pages, he will find in it passages of absorbing interest.

J. KENNETH PEARCE,
Seattle, Wash.

The Establishment of Vegetation on Industrial Waste Land.

By R. O. Whyte and J. W. B. Sisam. 78 pp. Illus. Joint Publication No. 14. Commonwealth Agricultural Bureau, Oxford, England. 1949. 10s.

The multiplicity of problems encountered and the wide variety of conditions that have to be overcome in the revegetation of industrial waste land in the British Isles is well described in this book.

The problem is far more acute in those countries where the density of population requires more intensive use of all available land areas. The difficulties encountered in revegetating all types of industrial waste areas ranging from open cast coal and iron mines to ash dumps, fire buck dumps, and various other types of industrial waste areas are included.

Various treatments, both successful and unsuccessful, that have been tried in different sections are described in considerable detail. The authors have drawn on published materials from Germany, France, South Africa, Cyprus, and the United States to compare the results obtained and the methods used in other countries with their methods and results.

The types of waste land encountered and the several factors affecting their treatment are covered in detail. Most significant is their finding that ". . . . it is only in really toxic media that artificial revegetation presents any serious difficulties. . . ." Here, where intensive reclamation has been under way for some years they have had more experience with leveling and the restoration of soil on top of worked out areas. As early as 1939 a report of the Ministry of Health points out that the cost of leveling and resoiling an area of iron ore workings was out of all proportion to the potential value of the land.

In the establishment of vegetation and the future use of waste areas, both the intention or object

of the planning authority and the habitat factors of the areas as they will influence the establishment and growth of vegetation are taken into consideration. The improvement of the landscape so as to provide recreation areas, land for the production of market garden crops, or areas for building sites is often of prime importance when the waste areas are in or adjacent to densely populated centers. In the more rural areas the deciding factor may be determined by the economies of the operation; that is, whether one type of vegetation can be established directly on the material whereas another type might require extensive leveling, the restoration of a soil cover or some other major treatment. The stabilization of banks to prevent erosion and the washing of the material onto adjacent land is considered of major importance.

The establishment of vegetation naturally and artificially are both discussed. The species of trees for planting on burned and unburned colliery waste and on quarry waste are recommended. Methods of establishment and the subsequent management of revegetation areas are covered. The procedure followed in the establishment of pastures and other herbaceous cover on different types of materials in several different sections of the islands is quite complete.

Reference is made to early plantings on old workings, the first about 1815, others in the early 1900's. Although very little is given on the growth of the trees, these plantings are recorded as successful. Photographs of plantings from 20 to 40 years old indicate their success.

The book is profusely illustrated. For one interested in the establishment of vegetation under adverse conditions it is well worth reading.

L. E. SAWYER,
Director, Forestry & Reclamation, Indiana Coal Producers Assn., Terre Haute.

The Trees of Pennsylvania.

By William C. Grimm. 363 pp. Illus. Stackpole and Hess, Inc., Harrisburg, Pa. 1950. $5.

Pennsylvania Trees by Joseph S. Illick, first published by the old Pennsylvania Department of Forestry in 1914, was reissued in numerous editions until, literally, the plates wore out. A useful and accurate book with a long and honored life, it served as a model for other texts on dendrology, but has been out of print more than twenty years.

The Trees of Pennsylvania is its lineal descendent, and a welcome offspring it is. The author, gracefully acknowledging his debt to Dr. Illick, has given us a tree book which is usable, interesting, and practical. Although the botanist and forester will find it worth consulting, this work is primarily for the person who is interested in trees, not professionally, but as living things, and who seeks a readily available answer when he asks himself, "What tree is that?"

Mr. Grimm has described all the trees native to Penn's Woods, together with introduced species that have been widely planted. In each case, the individual species is presented with a brief explanation of its distinguishing characteristics, that is, those features that are most easily recognized in identifying trees in the field.

There are full-page drawings of leaves, twigs, fruit, and flowers for each species described. The drawings are Mr. Grimm's own, and are a most practical aid in identification. Although scientific terms are for the most part avoided, there is an excellent glossary. The botanical nomenclature follows Rehder rather than Gray or *Standardized Plant Names*.

Recommended.

HENRY CLEPPER.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, The New York State College of Forestry*

Range Management Section Compiled by FRANCES FLICK, *Library, U. S. Department of Agriculture*

General

Finnish Forestry in Pictures; Special Edition of Finland's Wealth of Wood. Ed. by V. Lihtonen and others. Sinimen Kirja Osakeyhtio, Helsinki. 1949.

A Half Century of Forestry in a Democracy. 18 pp. American Forest Products Industries, Washington 6, D. C. 1950.

Pocket Guide to Alaska Trees. By R. F. Taylor and E. L. Little. 63 pp. Illus. U. S. Forest Serv. U. S. Dept. of Agric., Agric. Handbook No. 5. Revision of Misc. Publ. No. 55. Govt. Print. Off. 1950. 25 cents.

Redwood Country; The Lava Region and the Redwoods. By Alfred Powers. 292 pp. Duell, Sloan and Pearce, New York 16. 1949 $3.50.

Southern Forestry. By C. N. Elliott and M. D. Mobley. 494 pp. Illus. Turner E. Smith Co., Atlanta, Ga. 1949. $3.00.

Forest Influences

Effect of Rainfall on Stream Flow in Southeast Alaska. By L. W. Zach. 3 pp. Alaska Forest Research Center, Juneau. Tech. Notes No. 4. 1950.

Forest Management

Cubic Form Class Volume Tables for Southeast Alaska. 12 pp. Alaska Forest Research Center, Juneau. Tech. Notes No. 6. 1950.

Managing the Farm Woodlot in New Jersey. By A. N. Lentz. 12 pp. Illus. Rutgers Univ., New Brunswick. Leaflet No. 42. 1950.

Forest Products

Comparative Prices of Timber Imported From Russia, Finland and Sweden 1920-1940. 4 pp. Timber Development Ass'n., Ltd., 75 Cannon St., London E. C. 4.

Forest Resources

The Pine Forest of Louisiana. By B. L. Krebs. 17 pp. Louisiana Forestry Assoc., Alexandria. A series of articles reprinted from "*The Times Picayune*" Apr. 2-11, 1950.

Tennessee Valley Forest. By J. O. Artman. 17 pp. Illus. TVA Div. of Forestry Relations, Norris, Tenn. 1950.

Logging and Milling

Check List for Inspection of Lumber Dry Kilns. By H. H. Smith. 4 pp. California Forest and Range Expt. Sta., Berkeley. Research Note No. 69. 1950.

The Milling of "Ash" Eucalypts in the Christensen and Crozier Portable Log Edger Saw Mill. By G. W. Wright and H. D. Roberts. 16 pp. Illus. Forest Products Lab., South Melbourne, Aust.

Pathology

Decay of Timber and its Prevention. By K. St. G. Cartwright and W. P. K. Findlay. 294 pp. Illus. Chemical Publ. Co., Brooklyn. 1950. $7.50.

Protection

Getting at the Roots of Man-Caused Fires; A Case Study of a Southern Forest Area. By J. P. Shea. 46 pp. U. S. Forest Serv. Fire Prevention Studies Ser. A., No. 2. Rev. 1944, reissue 1950. Mimeog.

Range Management

Accomplishments in Soil and Moisture Operations in Grazing Districts, 1935 to 1948. By J. Killough and others. 83 pp. Illus. U. S. Bur. of Land Management, Washington 25, D. C. Mimeog.

The Brushland Plow. By T. Coldwell and J. F. Pechanec. 7 pp. U. S. Forest Serv., Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. Research Note No. 64. May 5, 1950. Mimeog.

Louisiana Pastures. By R. A. Wasson and W. E. Monroe. 23 pp. Illus. La. Agric. Ext. Serv., Baton Rouge. Pub. No. 1037. February, 1950.

Silviculture

Chemical Thinning of Young Stagnating Lodgepole Pine Stands. By D. I. Crossley. 2 pp. Canada Dept. of Res. & Devel., Ottawa. Silv. Leaflet No. 42. 1950. Mimeog.

Plant Ecology Work Book. By J. T. Curtis. 39 pp. . . [and] 75 hardwood forest data sheets. Burgess Publ. Co., Minneapolis. 1950. $1.75.

Precision Measurement of Radial Growth and Daily Radial Fluctuations in Douglas Fir. By G. Warrack and C. Joergensen. British Columbia Forest Serv., Victoria. Tech. Bul. No. 33 1950.

Resistance of Pine Hybrids to the Pine Reproduction Weevil. By J. M. Miller. 17 pp. Illus. Calif. Forest and Range Expt. Sta., Berkeley. Forest Res. Notes No. 68. 1950. Mimeog.

Profitable Tree Forms of Yellowpoplar. By Torkel Holsoe. 23 pp. West Va. Agric. Expt. Sta., Morgantown. Bul. No. 341. 1950.

Slash Disposal in Relation to Jack Pine Reproduction. By E. S. Atkins and J. L. Farrar. 2 pp. Canada Dept. of Res. & Devel., Ottawa. Silv. Leaflet No. 45. 1950. Mimeog.

Spot Wise Direct Seeding for Redwood. By Emanuel Fritz. pp. 334-38. Reprinted from Journal of Forestry, May 1950. Available free from the author, Univ. of Calif.

Windfirmness of Residual Spruce and Fir. By J. A. B. Kelly and I. C. M. Place. 2 pp. Canada Dept. of Res. & Devel., Ottawa. Silv. Leaflet No. 39. 1950. Mimeog.

Soil Conservation

Problems in Land Rehabilitation and Soil Conservation. 17 pp. Emory Univ., Emory, Ga. Studies in Bus. and Econ. No. 3. 1949. Free.

Wildlife Management

Fish and Wildlife in the Tennessee Valley. 17 pp. Illus. TVA Div. of Forestry Relations, Norris. 1950.

Wood Technology and Utilization

Die Forstbenutzung. 14 aufl. By Karl Gayer and Ludwig Fabricius. 734 pp. Illus. Paul Parey, Berlin. Fr. 38.50, as listed in Jour. For. Suisse. 1949.

Manufacture of Chemigroundwood Pulp from Hardwoods. By C. E. Libby and F. W. O'Neil. pp. 161-78. Illus. Reprinted from TAPPI, April 1950.

New Source of Chip Supply. By J. C. Hayes. 3 pp. Illus. Northeast Pulpwood Research Center, Gorham, N. H. 1950. Mimeog.

Southern Hardwood Buyers' Guide. 56 pp. Illus. Southern Hardwood Producers, Inc., Memphis 3, Tenn. 1950.

Society Affairs

Compiled by ROBERT D. HOSTETTER, *Assistant Executive Secretary*

Officers and Members of the Council, 1950-1951

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State Department of Conservation,
Lansing 12, Mich.

GORDON D. MARCKWORTH,
College of Forestry,
University of Washington,
Seattle 4, Wash.

EARL PORTER,
Southern Kraft Division,
International Paper Company,
Mobile 9, Ala.

Ladies' Activities Include Tea, Tour

Cornelia Bryce Pinchot, whose husband, the late Gifford Pinchot, was the first president of the Society of American Foresters, has extended an invitation to all ladies at the Golden Anniversary Meeting to attend a tea at the Pinchot residence, 1615 Rhode Island Avenue, Northwest, Washington, D. C. The tea will be from 4:00 to 6:00 p.m. on Thursday, December 14, 1950.

Many meetings of the Society of American Foresters during its early years were held in the very room where visiting ladies will enjoy Mrs. Pinchot's hospitality.

A conducted sight seeing tour arranged through the courtesy of the three host Sections—Washington, Allegheny, and Appalachian—is planned for ladies on Friday, December 15. Leaving the Mayflower Hotel at a comfortable hour that morning, chartered buses will go to Mount Vernon and points of interest in Arlington. A dutch lunch will be served in historic Alexandria. Buses will return sufficiently early in the afternoon to allow ample time for preparations to attend the dinner-dance at 7:30 p.m. in the Ballroom at the Mayflower.

No other group activities have been scheduled for visiting ladies, thus affording them the opportunity to spend time as desired visiting historic and art centers, shopping, visiting, and otherwise enjoying their visit to the capital city.

Members of the Ladies' Activities committee will be present at the meeting headquarters to register ladies for the tea and the tour and to provide information and assistance to guests. Mrs. Edward N. Munns heads the committee, and assisting her are Dr. Miriam L. Bomhard, Mrs. John D. Coffman, Miss Frances J. Flick, Mrs. R. D. Garver, Mrs. H. Richard Josephson, Mrs. Richard E. McArdle, and Mrs. George R. Phillips.

U. S. Forest Service

Mrs. Gifford Pinchot, who has extended an invitation to tea to ladies at the Golden Anniversary Meeting in December, is pictured above as hostess at the traditional Baked Apple Party for members of the Washington Section last May. Also pictured is George R. Phillips, chairman of the committee for the Golden Anniversary Meeting.

Detailed Poll Seeks Attitude on Regulation

A random cross-section of the membership of the Society of American Foresters is being asked in effect, "How do you really feel about public regulation of private forestry?" John H. Farrell, research assistant, Department of Forest Management, New York State College of Forestry, has sent questionnaires to 1,005 members of the Society to determine the degree to which professional foresters are willing to accept the principle of regulation by the various levels of government.

Scientifically designed according to accepted methods used in public opinion analysis, the comprehensive three-page questionnaire is to be answered anonomously. A wide range of opinion is covered—from complete federal control to no governmental control at any level.

Upon completion of the study, findings will be published in the JOURNAL OF FORESTRY.

One Thousand Foresters Apply for Membership

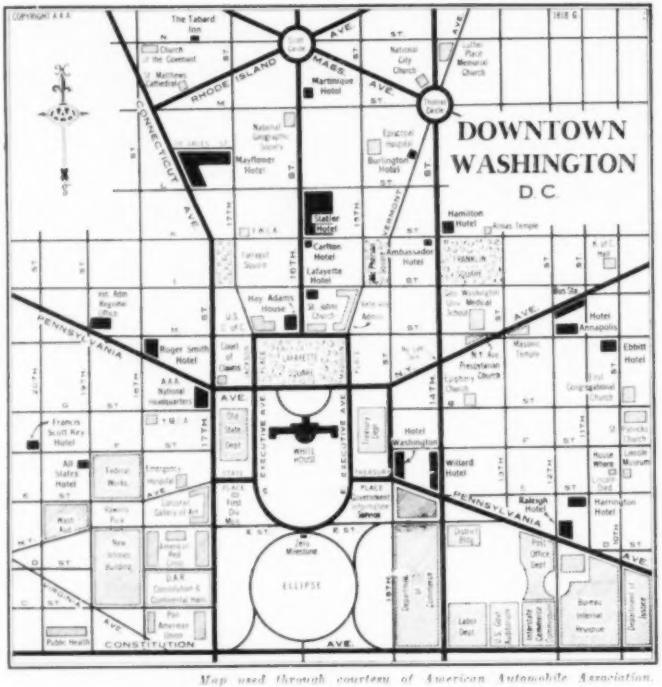
During the eight-month period from December 1, 1949 to July 31, 1950 a total of 1,014 foresters applied for Junior Membership in the Society of American Foresters. Of these, 560 were 1950 graduates of the 22 accredited forestry schools.

Total membership on August 1, 1950 was 6,799.

Golden Anniversary Facilities Arranged

H. R. Josephson and his Information and Welcome Subcommittee for the Golden Anniversary Meeting have made arrangements to ensure the convenience and enjoyment of members and their families who attend the Society's fiftieth annual meeting on December 13-16, 1950, Washington, D. C.

Members of the three host Sections —Washington, Allegheny, and Appalachian—will welcome guests, provide information about the meeting schedule, conference rooms, location of local forestry organizations, points of interest, and other subjects. The committee has made available an attractive brochure, "Highlights of the Nation's Capital," which includes a map of the city. Copies may be obtained in advance of the meeting by requesting them from the Society office. The Information and Welcome Subcommittee will maintain an information desk where messages can be left for delivery and where the registration file will be available. A bulletin board will be maintained for posting notices of alumni gatherings which have been scheduled for Thursday evening, December 14.



Map used through courtesy of American Automobile Association.

Hotel Reservations

Arrangements have been made for all requests for hotel room reservations to be handled through the Society office. With this issue of the JOURNAL is a registration card for use in requesting reservations. Reservations should be made during September or early October if at all possible, in order to secure the type of accommodation desired.

The Mayflower Hotel, Connecticut Avenue and DeSales Street, is the headquarters for the meeting, with the general sessions, dinner-dance, and most of the Division meetings being held there. However, the Mayflower cannot accommodate all members. Accordingly, arrangements have been made with suitable nearby hotels to make rooms available for members attending the Golden Anniversary Meeting. Most of these hotels are shown on the accompanying map. Taxi fare from hotels not within walking distance is 30 cents, individual rate, or 20 cents, group rate.

The Society office is located on the eighth floor of the same building in which is located the national headquarters of the American Automobile Association at 17th and Pennsylvania Avenue, Northwest.

Listed below are hotels where reservations can be made through the office of the Society of American Foresters, 825 Mills Building, Washington 6, D. C. All rates quoted are for rooms with bath. In addition to rooms with single, double, or twin beds, most hotels can provide suites.

Mayflower Hotel, Connecticut Avenue and DeSales Street, N. W. Single, $5.50, $6.50, $7.00, $7.50, $8.50; double, $10.00, $10.50, $11.50, $12.50; twin, $10.50, $11.50, $12.00, $13.00, $14.00, $16.00.

Martinique Hotel, 16th and M Streets, N. W. Single, $4.00, $5.00, $6.00; double, $6.00, $7.00, $8.00; twin, $7.00, $8.00.

The Lee House, 15th and L Streets, N. W. Single, $5.00, $5.50, $6.00, $7.00; double, $8.50, $9.00, $9.50; twin, $7.00, $8.00.

Hotel Statler, 16th and K Streets, N. W. Single, $5.00 to $12.00; double, $8.00 to $13.00; twin $9.50 to $14.50.

Lafayette Hotel, 16th and I Streets, N. W. Single, $4.00, $5.00; double, $7.00; twin, $8.00.

Hay-Adams House, 16th and H Streets, N. W. Single, $5.00, $6.00, $7.00; double, $7.00, $8.00; twin, $8.00, $9.50.

Roger Smith Hotel, 18th and Pennsylvania Avenue, N. W. Single, $4.50 to $7.00; double, $6.00 to $9.00; twin, $6.50 to $9.50.

Burlington Hotel, 1120 Vermont Avenue, N. W. Single, $5.00; double, $8.00; twin, $8.00.

Hamilton Hotel, 14th and K Streets, N. W. Single, $4.25, $4.75, $5.25, $5.75; double, $6.75, $7.75; twin, $7.75, $8.25.

Ambassador Hotel, 14th and K Streets, N. W. Single, $4.00, $4.50, $5.00, $6.00; double, $7.00, $7.50, $8.00, $8.50, $9.00; twin, $8.00, $8.50, $9.00, $10.00.

Hotel Annapolis, 12th and H Streets, N. W. Rates not to exceed: Single, $5.00; double, $7.50; twin, $7.50.

Harrington Hotel, 11th and E Streets, N. W. Single, $4.00; double, $6.00, $6.50; twin $7.50.

Raleigh Hotel, 12th and Pennsylvania Avenue, N. W. Single, $4.50, $5.00, $5.50, $6.00, $6.50, $7.50; double $6.50, $7.00, $7.50, $8.00, $9.00, $10.00, $11.00; twin, $8.00, $9.00, $10.00, $11.00, $12.00.

Roosevelt Hotel, 16th and Florida Avenue, N. W. Single $4.00, $5.00, $6.00, $7.00; double, $6.00, $7.00, $8.00, $9.00; twin, $7.00, $8.00, $9.00, $10.00.

Some hotels provide group rates for from three to eight persons. Because

single rooms will be limited, all members are encouraged to team up when possible.

Confirmation of reservations will be mailed direct to members by the hotel where space is reserved.

The first general session of the meeting begins at 9:30 a.m., Thursday, December 14, and the final session closes at noon, Saturday, December 16, 1950. Meetings of the Division of Education, Section delegates, and the Council will be on Wednesday, December 13.

Evans Notifies Senators Of Regulation Opposition

The following letter was sent on July 12, 1950 by President Charles F. Evans to Secretary of Agriculture Charles F. Brannan and to each member of the Senate Committee on Agriculture and Forestry. Members of the committee are Elmer Thomas, Okla., chairman; Allen J. Ellender, La.; Scott W. Lucas, Ill.; Clyde R. Hoey, N. C.; Olin D. Johnson, S. C.; Spessard L. Holland, Fla.; Guy M. Gillette, Iowa; Clinton P. Anderson, N. Mex.; George D. Aiken, Vt.; Milton R. Young, N. Dak.; Edward J. Thye, Minn.; James P. Kem, Mo.; and Bourke B. Hickenlooper, Iowa.

DEAR SIR:

Senate bill 1820, introduced by Senator Anderson, would establish the principle of direct federal regulation of private forests, unless states within three years enact legislation in a form acceptable to the Secretary of Agriculture, under threat of withdrawing all appropriations for this or any other joint federal-state forestry program.

In order to determine the attitude of the membership of the Society of American Foresters, a national organization of professional foresters, on the principle involved, a mail referendum was held on May 26, 1950, on the following question:

"Shall the Society of American Foresters through its Council favor or oppose the principle of federal regulation of private forests, and federal legislation looking to the establishment of this principle?"

Of the 3,652 members who returned ballots, 2,545 voted to oppose the principle of federal regulation of private forests; 1,107 voted to approve the principle.

At a recent meeting of the Council of the Society, I was instructed to inform you about the results of this referendum; and that the majority opinion of the members of the Society is opposed to the provisions of S. 1820 which would establish the principle of federal regulation of private forests.

Yours respectfully,
C. F. EVANS,
President.

When the JOURNAL went to press on July 31, the following replies to Mr. Evans' letter had been received:

July 14, 1950

DEAR MR. EVANS:

This will acknowledge your favor of recent date setting forth the outcome of a mail referendum held by your Society in connection with legislation now before this committee; namely, S. 1820.

For your information no action is scheduled on this bill and I am of the opinion that no action will be taken during this Congress.

Thanking you for affording me this information as to the views of your Society, and with all good wishes, I am

Sincerely,
ELMER THOMAS.

July 14, 1950

DEAR MR. EVANS:

Thank you for your letter of July 12, advising me of the result of the mail referendum held to determine the attitude of your Society with regard to the Anderson bill, S. 1820.

I am opposed to the Anderson bill, which as you state would establish the principle of direct Federal regulation of private forests, unless the states should within three years enact legislation acceptable to the Secretary of Agriculture. I appreciate your cooperation in furnishing me the views of the Society of American Foresters regarding this proposed legislation.

With best wishes, I am

Sincerely yours,
ALLEN J. ELLENDER.

July 14, 1950

DEAR SIR:

I have your letter of July 12, 1950, in regard to S 1820, introduced by Senator Anderson, and I note the vote by members of your organization with reference to this measure.

I am glad to have the result of this referendum and I assure you I shall give it full consideration when it comes up for action.

With best wishes, I am

Yours very truly,
CLYDE R. HOEY.

July 25, 1950

DEAR MR. EVANS:

Thank you for your letter of July 12, setting forth the views of your Society with reference to S. 1820, introduced by Senator Anderson. I am glad to have this information for my file and appreciate your courtesy in writing me on the subject.

With cordial greetings, I remain

Yours faithfully,
SPESSARD L. HOLLAND.

July 14, 1950

MY DEAR PRESIDENT:

Thank you for your good letter of July twelfth, calling attention to the poll of your organization voicing opposition to Senate bill 1820.

Sincerely,
GUY M. GILLETTE.

July 17, 1950

DEAR MR. EVANS:

I have your letter of July 12th regarding S. 1820.

I have noted the report of the results of the referendum conducted by your Society.

Sincerely yours,
GEORGE D. AIKEN.

July 15, 1950

DEAR MR. EVANS:

Thank you kindly for your letter of July 12th with regard to the opposition of the members of your Society against the passage of S. 1820.

This expression of your views is appreciated, and you may be sure that I will remember your letter when this measure is before the Senate for consideration.

With kindest regards,

Sincerely yours,
MILTON R. YOUNG.

July 17, 1950

DEAR MR. EVANS:

This will acknowledge receipt of your letter of July 12 referring to S. 1820, as introduced by Senator Anderson. I have read with keen interest the results of the mail referendum you conducted. Thank you for giving me this information.

Sincerely yours,
EDWARD J. THYE.

July 14, 1950

DEAR MR. EVANS:

Thank you for your letter of July 12 concerning S. 1820.

I appreciate your thoughtfulness in giving me the benefit of the results of the poll conducted by your organization in regard to this legislation.

With best wishes, I am

Sincerely yours,
JAMES P. KEM.

Allegheny Members View College Research

More than 125 members and guests of the Society attended the annual summer meeting of the Allegheny Section at State College, Pa., July 27-29. Except for one evening session at which the motion pictures in *The Living Earth Series* was shown, the meeting consisted of field trips to view the forestry experiments of the Pennsylvania State College.

Members of the College Department of Forestry explained the management plan of the College Farm woodlands, experiments in poisoning of hardwoods to facilitate pulpwood peeling, fence post tests, and plantation management. Results of use of foliage sprays, and chemical killing of dormant stumps were shown. Visits were made to the department's new sawmill for a demonstration of sawing and grading, and members were given an opportunity to operate the Asplundh wood chipper. At the Stone Valley forestry camp, a site leased from the U. S. Forest Service and treated as an experiment in multiple use, studies of regeneration and management of Virginia pine were examined.

The program was arranged and conducted by David P. Worley and other members of the Department of Forestry staff.

Section Officers

(As of September 15, 1950. Dates terms began are given.)

Allegheny Section

2-17-50

J. Ira Kolb, Chairman
Parvin State Park, R. D. 1, Elmer, N. J.

M. K. Goddard, Vice Chairman
Pennsylvania State Forest School, Mont Alto, Pa.

J. H. Mendenhall, Secretary-Treasurer
405 F & M Building, West Chester, Pa.

M. K. Goddard, Membership Chairman
Pennsylvania State Forest School, Mont Alto, Pa.

Chapters: 1. New Jersey
2. Philadelphia
3. West Virginia

Appalachian Section

1-22-50

A. E. Wackerman, Chairman
School of Forestry, Duke University, Durham, N. C.

Theodore Davis, Vice Chairman
Forestry Department, Champion Paper & Fibre Co., Canton, N. C.

P. A. Griffiths, Secretary-Treasurer
Department of Conservation and Development, Raleigh, N. C.

Theodore Davis, Membership Chairman
Forestry Department, Champion Paper & Fibre Co., Canton, N. C.

Chapters: None

Central Rocky Mountain Section

5-13-50

Ralph R. Hill, Chairman
U. S. Forest Service, Denver 2, Colo.

Ralph C. Bryant, Vice Chairman
Division of Forestry and Range Management, Colorado A & M College, Fort Collins, Colo.

Warren M. Tracy, Secretary-Treasurer
U. S. Forest Service, Denver 2, Colo.

Ralph C. Bryant, Membership Chairman
Division of Forestry and Range Management, Colorado A & M College, Fort Collins, Colo.

Chapters: 1. Black Hills

Central States Section

10-27-49

Roy Brundage, Chairman
Department of Forestry, Purdue University, Lafayette, Ind.

Warren W. Chase, Vice Chairman
University of Michigan, Ann Arbor, Mich.

Charles S. Walters, Secretary-Treasurer
219 New Agriculture Building, Urbana, Ill.

Warren W. Chase, Membership Chairman
University of Michigan, Ann Arbor, Mich.

Chapters: 1. Illinois Technical Forestry Association
2. Indiana
3. Lower Michigan
4. Ohio

Columbia River Section

7-1-50

Clarence Richen, Chairman
4404 N. E. 32nd Place, Portland 11, Oreg.

L. O. Barrett, Vice Chairman
801 W. 8th Street, Vancouver, Wash.

Norman E. Bjorklund, Secretary
West Coast Lumbermen's Association, 1410 S. W. Morrison Street, Portland 5, Oreg.

Carwin A. Woolley, Treasurer
100 S. E. 47th Avenue, Portland 15, Oreg.

L. O. Barrett, Membership Chairman
801 W. 8th Street, Vancouver, Wash.

Chapters: 1. Central Oregon
2. Hawaii
3. Longview
4. Portland
5. Shasta-Cascade
6. Siskiyou
7. Umpqua-Coquille
8. Willamette

Gulf States Section

5-4-50

J. H. Kitchens, Jr., Chairman
Box 1269, Baton Rouge, La.

W. M. Palmer, Jr., Vice Chairman
Box 168, Natchitoches, La.

J. W. Myers, Jr., Secretary-Treasurer
Box 894, Baton Rouge, La.

W. M. Palmer, Jr., Membership Chairman
Box 168, Natchitoches, La.

Chapters: 1. Fort Worth-Dallas
2. Houston-Huntsville-College Station
3. Jackson
4. Longleaf
5. Lufkin-Nacogdoches
6. North Louisiana
7. North Mississippi
8. Florida Parishes
9. Southwest Louisiana

Inland Empire Section

5-20-50

M. M. Mosher, Chairman
Department of Forestry, Washington State College, Pullman, Wash.

Earl Ritzheimer, Vice Chairman
Potlatch Forests, Inc., Bovill, Idaho

George Weyerman, Secretary-Treasurer
U. S. Forest Service, Orofino, Idaho

Hans Roffler, Membership Chairman
U. S. Forest Service, Coeur d'Alene, Idaho

Chapters: None

Intermountain Section

7-1-50

T. W. Daniel, Chairman
Utah State Agricultural College, Logan, Utah

James M. Hockaday, Vice Chairman
U. S. Forest Service, Ogden, Utah

Raymond R. Moore, Secretary-Treasurer
Utah State Agricultural College, Logan, Utah

James M. Hockaday, Membership Chairman
U. S. Forest Service, Ogden, Utah

Chapters: None

Kentucky-Tennessee Section

11-17-49

J. O. Artman, Chairman
Division of Forestry Relations, Tennessee Valley Authority, Norris, Tenn.

Maxwell MacMaster, Vice Chairman
Stanley, Inc., Pulaski, Tenn.

F. Henry Sipe, Secretary-Treasurer
Winchester, Ky.

Maxwell MacMaster, Membership Chairman
Stanley, Inc., Pulaski, Tenn.

New England Section

2-24-50

William C. MacAdam, Chairman
Francestown, N. H.

R. S. Monahan, Vice Chairman
Hanover, N. H.

Edwin L. Giddings, Secretary-Treasurer
Penobscot Development Co., Great Works, Me.

R. S. Monahan, Membership Chairman
Hanover, N. H.

Chapters: None

New York Section

12-10-49

Albert J. Woodford, Chairman
Box 84, Herkimer, N. Y.

Fred E. Winch, Vice Chairman
New York State College of Agriculture, Ithaca, N. Y.

David B. Cook, Secretary-Treasurer
14 Nolan Road, Albany 5, N. Y.

L. P. Plumley, Membership Chairman
New York State College of Forestry, Syracuse 10, N. Y.

Chapters: 1. Adirondack
2. Black River Valley
3. Capital District
4. Iroquois
5. Longhouse
6. Metropolitan
7. Mid-Hudson
8. Ontario
9. Upper Hudson
10. Western New York

Northern California Section

7-1-50

P. A. Thompson, Chairman
U. S. Forest Service, 630 Sansome Street, San Francisco 11, Calif.

R. D. Roseberry, Vice Chairman
Diamond Match Company, Stirling City, Calif.

T. H. Harris, Secretary-Treasurer
Blister Rust Control, 2288 Fulton Street, Berkeley 4, Calif.

John Zivnuska, Membership Chairman
School of Forestry, Univ. of California, Berkeley 4, Calif.

Chapters: 1. Bay Area
2. Eldorado-Amador
3. Feather River
4. Redding
5. Redwood
6. Sacramento
7. San Joaquin

Northern Rocky Mountain Section

5-1-50

Clayton S. Crocker, Chairman
U. S. Forest Service, Missoula, Mont.
Tom A. Walbridge, Jr., Vice Chairman
School of Forestry, Montana State University, Missoula, Mont.
Cameron J. Warren, Secretary-Treasurer
521 Hartman St., Missoula, Mont.
S. B. Hutchison, Membership Chairman
Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Mont.
Chapters: None

Ozark Section

2-4-50

W. E. Towell, Chairman
Assistant State Forester, Jefferson City, Mo.
Nat Walker, Vice Chairman
344 Adm. Road, Stillwater, Okla.
Gordon D. Hartrick, Secretary-Treasurer
Fountain Hill, Ark.
Hamlin L. Williston, Membership Chairman
Crossett Experimental Forest, Crossett, Ark.
Chapters: 1. Missouri
2. Oklahoma
3. Southeast Arkansas

Puget Sound Section

11-4-49

V. W. Bousquet, Chairman
Box 133, Centralia, Wash.
D. R. Hopkins, Vice Chairman
1515 Section Street, Mt. Vernon, Wash.
William A. Tinney, Secretary-Treasurer
4444 White-Henry-Stuart Building, Seattle 1, Wash.
John Cameron, Membership Chairman
P. O. Box 231, Roy, Wash.
Chapters: 1. Alaska
2. British Columbia
3. North Olympic
4. Southwest Washington

Southeastern Section

1-28-50

B. E. Allen, Chairman
Union Bag & Paper Co., 801 Liberty Bank Building, Savannah, Ga.
C. H. Coulter, Vice Chairman
P. O. Box 1200, Tallahassee, Fla.
James F. Spiers, Secretary-Treasurer
317 S. Main Street, Statesboro, Ga.
Jack May, Membership Chairman
Alabama Polytechnic Institute, Auburn, Ala.
Chapters: 1. Alabama
2. Florida
3. Georgia

Southern California Section

7-1-50

B. H. Paul, Chairman
524 North Spring Street, Los Angeles, Calif.
Robert H. Parsons, Vice Chairman
3047 Paraiso Way, La Crescenta, Calif.
Keith K. Knutson, Secretary-Treasurer
Box 871, Pasadena 20, Calif.
Robert H. Parsons, Membership Chairman
3047 Paraiso Way, La Crescenta, Calif.
Chapters: None

Southwestern Section

6-28-50

James A. Egan, Chairman
Box 556, Albuquerque, N. Mex.
John R. J. Bradshaw, Vice Chairman
2719 Santa Cruz Drive, Albuquerque, N. Mex.
Bruce H. Eastman, Secretary-Treasurer
1706 Anderson Place, Albuquerque, N. Mex.
Lemuel A. Garrison, Membership Chairman
Grand Canyon National Park, Grand Canyon, Ariz.
Chapters: None.

Upper Mississippi Valley Section

8-26-49

Clarence Prout, Chairman
5552 24th Avenue, South, Minneapolis, Minn.
Raymond Wood, Vice Chairman
625 Spruce Street, Cloquet, Minn.
Henry Hansen, Secretary-Treasurer
School of Forestry, University Farm, St. Paul, Minn.
L. B. Ritter, Membership Chairman
338 State Office Building, St. Paul, Minn.
Chapters: 1. Iowa
2. Lake Superior
3. North Dakota
4. Northwest
5. Southern

Washington Section

6-22-50

C. W. Mattison, Chairman
U. S. Forest Service, 3220 South Agriculture Bldg., Washington 25, D. C.
Seth Jackson, Vice Chairman
U. S. Forest Service, 4233 South Agriculture Bldg., Washington 25, D. C.
Frances J. Flick, Secretary-Treasurer
1650 Harvard Street, N.W., Apt. 703, Washington 9, D. C.
Vance B. Tribbett, Membership Chairman
Room 5545, Interior Bldg., Washington 25, D. C.
Chapters: None

Wisconsin-Upper Michigan Section

2-25-50

William J. Brown, Chairman
317 Sherry Street, Neenah, Wis.
Jordan Korotev, Secretary-Treasurer
P. O. Box 361, Green Bay, Wis.
Jordan Korotev, Membership Chairman
P. O. Box 361, Green Bay, Wis.
Chapters: 1. Madison
2. Milwaukee
3. Northeastern Wisconsin

S.A.F. Consulting Foresters List To Be Published in January JOURNAL

November 1, 1950 is the deadline for consulting foresters to apply for listing in the Society of American Foresters' List of Consulting Foresters which is to be published next in the January 1951 JOURNAL OF FORESTRY.

Minimum requirements for listing are membership in the Society and the designation of fields of specialization commensurate with the consultant's training and experience as shown in the official Society records.

Consulting firms will be listed if one or more of the partners or employees are members of the Society and capable of performing the services offered. In such cases, those individuals' names will appear in the listing.

Persons and firms in the S.A.F. List of Consulting Foresters which was published on pages 62-67 of the January 1950 JOURNAL have been contacted by mail to obtain corrections or revisions of their listings.

Members who are doing consulting forestry work and who have not been listed previously are invited to apply for inclusion in the S.A.F. list. They should provide complete information concerning address, specializations, and territory served, following the form used in the List of Consulting Foresters published in the January 1950 JOURNAL OF FORESTRY. A limited number of reprints of that list are available for free distribution.

November 1, 1950 is the last date on which listings will be accepted for publication in the January 1951 list.

Queries and Quotes

"Fortunately, this somewhat isolated location does not prevent my active participation in Society affairs as we now have an active Chapter in the North Olympic Peninsula area. It appears to me that such Chapters scattered throughout the country in sufficient numbers will do much to strengthen the Society and insure active participation by an increasing number of foresters."—C. E. T.

Coming Events

Central States Section

The annual meeting of the Central States Section will be held September 21 to 23, 1950 at the Clark State Forest in southern Indiana.

Additional details can be had from Roy C. Brundage, the Section's chairman, whose address is Department of Forestry, Purdue University, Lafayette, Ind.

Candidates for Membership

Candidates for membership whose applications were received in the Society office prior to August 1, 1950 are listed below. Names, positions, addresses, and education are given.

Action regarding the eligibility of these candidates will be taken by the Council as of October 1, 1950. Comments, protests, or important information regarding the qualifications for membership of candidates listed are invited from present voting members. All such communications are kept strictly confidential, being used only by the Council in taking final action on applications. Correspondence should be received in the Society office prior to October 1, 1950.

The names of those candidates who are elected will be published in the Society Affairs department of the November 1950 JOURNAL OF FORESTRY. The names of those who signify their acceptance of election will be published in subsequent issues of the JOURNAL.

Allegheny Section

Junior Grade

Bell, R. J., 507 Delaware St., Forest City, Pa.; Pa. State, B.S.F., 1950.

Drury, P. R., Sr. Forester, Dept. of Forests and Waters, Harrisburg, Pa.; Pa. State, B.S.F., 1949.

Ellsbury, W. M., Forestry Aide, U.S.F.S., Laurel, Md.; Colo. A. & M., B.S.F., 1941.

Hanna, W. H., Franklin Village, Morristown, N. J.; Colo. A. & M., B.S.F., 1950.

Krayer, W. J., 1512 Shenk Ave., Erie, Pa.; Purdue, B.S.F., 1950.

Lavin, J. J., 223 S. 57th St., Phila., Pa.; Pa. State, B.S.F., 1950.

McAninch, G. E., R.F.D. #1, Strattonville, Pa.; Pa. State, B.S.F., 1950.

Neupauer, T. W., 1547 Louisa St., Williamsport, Pa.; Pa. State, B.S.F., 1950.

Phelps, W. R., Monkton, Md.; N. C. State, B.S.F., 1950.

Porter, J. A., 94 C St., Keyser, W. Va.; W. Va. Univ., B.S.F., 1949; Duke, M.F., 1950.

Rondum, S. B., 31 Summer St., Bradford, Pa.; Pa. State, B.S.F., 1950.

Roncik, R. H., 59 Elmhurst Ave., Trenton, N. J.; N. C. State, B.S.F., 1949.

Member Grade

Ehrhart, E. O., Box 205, Johnsonburg, Pa.; Pa. State, B.S.F., 1913. Reinstatement.

Appalachian Section

Junior Grade

Biddix, F. W., Jr., Box A, Spruce Pine, N. C.; N. C. State, B.S.F., 1950.

Carvell, K. L., Duke School of Forestry, Durham, N. C.; Harvard College, B.A., 1949; Yale, M.F., 1950.

Curle, L. D., 8 Ferndale Lane, Raleigh, N. C.; N. C. State, B.S.F., 1950.

Dallas, H. G., Jr., Carolina Power and Light Co., Raleigh, N. C.; N. C. State, B.S.F., 1950.

Fournier, J. P., c/o C. E. Blair, Dry Fork, Va.; Univ. of Me., B.S.F., 1950.

Funderburke, K. P., 8 Hampton Court, Walterboro, S. C.; Univ. of Ga., B.S.F., 1949.

Green, H. J., Rt. #2, Whiteville, N. C.; N. C. State, B.S.F., 1949.

Hawkins, W. T., Koppers Co., Inc., Charleston, S. C.; Furman Univ., B.S., 1948; Duke, M.F., 1950.

Keller, W. M., Forestry Ext. Spec., N. C. State, Raleigh, N. C.; N. C. State, B.S.F., 1947.

Mulkey, M. A., 229 E. Park Ave., Charlotte, N. C.; N. C. State, B.S.F., 1949.

Newman, W. P., Jr., Forester, Nantahala Natl. Forest, Franklin, N. C.; V.P.I., B.S., 1943; Duke, M.F., 1950.

Pierce, W. L., 409 E. Second St., Farmville, Va.; N. C. State, B.S.F., 1950.

Rankin, J. R., 528 East Front St., New Bern, N. C.; N. C. State, B.S.F., 1949.

Smith, B. F., Forest Asst., Duke School of Forestry, Durham, N. C.; N. C. State, B.S.F., 1949; Duke, M.F., 1950.

Spers, C. F., 78 Larchmond Rd., Asheville, N. C.; N. Y. State, B.S.F., 1938, M.S., 1940.

Spivey, J. F., Jr., Box 5802, State College Sta., Raleigh, N. C.; N. C. State, B.S.F., 1950.

Todd, D. P., 305 Sumter St., Charleston, S. C.; Univ. of Ga., B.S.F., 1949; M.F., 1950.

Central Rocky Mountain Section

Junior Grade

Mattoon, J. A., U.S.F.S., Red Feather Lakes, Colo.; Pa. State, B.S.F., 1942; Yale, M.F., 1949.

Nobles, R. W., 1043 Cherokee, Denever, Colo.; Colo. A. & M., B.S.F., 1950.

Slater, J. P., Jr., 2337 S. 33rd St., Omaha Nebr.; Colo. A. & M., B.S.F., 1950.

Central States Section

Junior Grade

Baumann, O. H., 23345 Nona, Dearborn, Mich.; Univ. of Mich., B.S.F., 1950.

Kelley, R. J., Albert E. Sleeper State Park, Caseville, Mich.; Univ. of Mich., B.S.F., 1950.

Knudsen, L. L., Dept. of Forestry, Wooster, Ohio; Morningside College, B.S., 1946; Duke, M.F., 1950.

Misa, Frank, 4100 W. 25th St., Chicago, Ill.; Mich. State, B.S.A., 1950.

Somers, W. A., R.F.D. #1, Perrinton, Mich.; Mich. State, B.S.A., 1950.

Ursic, S. J., Dixon Springs Exp. Sta., Robbs, Ill.; Univ. of Minn., B.S.F., 1949; Yale, M.F., 1950.

Watt, J. C., 503 Longwood Ave., Glencoe, Ill.; Univ. of Chicago, B.A., 1943; Yale, M.F., 1950.

Columbia River Section

Junior Grade

Flink, C. F., Snow Mt. Rgr. Dist., Burns, Oreg.; Univ. of Minn., B.S.F., 1950.

Griffin, J. B. % Mrs. Lucy Smith, Lakeview, Oreg.; Univ. of Calif., B.S.F., 1950.

Pater, R. K., 8456 S. W. 30th Ave., Portland, Oreg.; Univ. of Calif.

Gulf States Section

Junior Grade

Bowling, D. R., Box 998, Clarksdale, Miss.; N. C. State, B.S.F., 1950.

Briscoe, C. B., Box 217, Sicily Island, La.; La. State, B.S.F., 1950.

Flanagan, C. M., Forester, U.S.S.C.S., New Albany, Miss.; Reinstatement.

Shaw, M. N., Jr., Goodfellow Air Force Base, Tex.; N. C. State, B.S.F., 1949.

Inland Empire Section

Junior Grade

Williams, E. L., 735 E. 8th St., Moscow, Idaho; Univ. of Idaho, B.S.F., 1950.

Intermountain Section

Junior Grade

Tkach, J. G., Cottonwood Rgr. Sta., Boise, Idaho; Univ. of Idaho, B.S.F., 1950.

New England Section

Junior Grade

Brown, P. L., Eaton Sta., Me.; Univ. of Me., B.S.F., 1950.

Burgess, A. W., R.F.D. #1, Kennebunk, Me.; Univ. of Me., B.S.F., 1950.

Horner, C. E., 34 Greenwood Rd., Wellesley Hills, Mass.; Univ. of Me., B.S.F., 1949; Yale, M.F., 1950.

Natti, T., 1142 Washington St., Gloucester, Mass.; Univ. of N. H., B.S.F., 1949; Yale, M.F., 1950.

Sheffield, H. S., Alexandria, N. H.; Univ. of N. H., B.S.F., 1949; Yale, M.F., 1950.

Thorne, H. W., 213 Water St., Wakefield, Mass.; Univ. of Mass., B.S., 1949; Duke, M.F., 1950.

Northern California Section

Junior Grade

Boring, W. R., 6257 Girvin Drive, Oakland, Calif.; Univ. of Calif., B.S.F., 1950.

Brown, R. L., 2708 Channing Way, Berkeley, Calif.; Univ. of Calif., B.S.F., 1950.

Bruton, Q. H., 831 Fell St., Redding, Calif.; Univ. of Calif., B.S.F., 1950.

Callahan, D. T., 2501 Durant Ave., Berkeley, Calif.; Univ. of Calif., B.S.F., 1950.

Carr, S. B., 205 Homassell Ave., Lindsay, Calif.; Univ. of Calif., B.S.F., 1950.

Doner, M. H., 5537 Telegraph Ave., Oakland, Calif.; Univ. of Calif., B.S.F., 1950.

Durbin, J. H., 225 Maine, Richmond, Calif.; Univ. of Calif., B.S.F., 1950.

Falconer, P. W., 3015 Benvenur Ave., Berkeley, Calif.; Univ. of Calif., B.S.F., 1950.

Graham, W. C., Jr., 942 G St., Eureka, Calif.; Univ. of Calif., B.S.F., 1950.

Hall, D. O., 340 Palo Alto Ave., Santa Clara, Calif.; Univ. of Calif., B.S.F., 1950.

Ingraham, R. H., 2636 Haste St., Berkeley, Calif.; Univ. of Calif., B.S.F., 1950.

Jackson, W. L., 438 Roop St., Susanville, Calif.; Univ. of Mich., B.S.F., 1950.

Koll, E. J., 2931 Magnolia St., Berkeley, Calif.; Univ. of Calif., B.S.F., 1941.

Koster, F. W., 700 Parnassus Ave., San Francisco, Calif.; Univ. of Calif., B.S.F. 1950.

Langley, P. G., Gen. Del., Chester, Calif.; Univ. of Calif., B.S.F., 1950.

Macpherson, W. R., Star Route, Box 39, Eureka, Calif., Univ. of Calif., B.S.F., 1950.

Merritt, R. A., 123 26th St., Merced, Calif.; Univ. of Calif., B.S.F., 1950.
Miller, H., Jr., 1767 Euclid Ave., Berkeley, Calif.; Univ. of Calif., B.S.F., 1950.
Nicklos, J. F., 2425 Ridge Rd., Berkeley, Calif.; Univ. of Calif., B.S.F., 1950.
Saukko, R. W., 2837 14th St., Eureka, Calif.; Univ. of Calif., B.S.F., 1950.
Taylor, G. W., Rt. No. 1, Reedley, Calif.; Univ. of Calif., B.S.F., 1950.

Northern Rocky Mountain Section

Junior Grade

Finch, B. R., Yellowstone Park, Wyo.; Univ. of Oreg., B.S., 1935.

Ozark Section

Junior Grade

Bender, F. J., Asst. Dist. Forester, Mo. Cons. Comm., Jefferson City, Mo.; N. Y. State, B.S.F., 1949.
Whitt, F. B., Dist. Forester, Ellington, Mo.; Univ. of Mich., B.S.F., 1947.

Puget Sound Section

Junior Grade

Bohlig, R. W., 4622 N. Visscher St., Tacoma, Wash.; Mont. State, B.S.F., 1950.
DeVoe, A. H., 4616 21st Ave., N.E., Seattle, Wash.; Univ. of Wash., B.S.F., 1950.
Host, J. R., 703 E. 3rd St., Ellensburg, Wash.; Univ. of Calif., B.S.F., 1950.
Smith, J. H. G., 761 Pleasant St., Kamloops, B. C., Can.; Univ. of B. C., B.S.F., 1949; Yale, M.F., 1950.

Southeastern Section

Junior Grade

Mathews, J. B., Talladega, Ala.; A.P.I., B.S., 1948.
Meigs, H. K., P.O. Box 247, Carrollton, Ala.; A.P.I., B.S., 1949.
Olander, D., The Prado, Montgomery, Ala.; N. Y. State, B.S.F., 1924.
Olive, C. L., Jr., 1319 Sherrod Ave., Florence, Ala.; A.P.I., B.S., 1948.
Welch, J. J., 225 Peachtree Rd., Gainesville, Ga.; Cornell Univ., B.S.F., 1932. Reinstatement.

Member Grade

Woodman, J. E., Industrial Forester, Jacksonville, Fla.; Univ. of Mich., B.S.F., 1918. (Junior, 24R50).

Southern California Section

Junior Grade

Cermak, R. W., 208 Granger Ave., National City, Calif.; Univ. of Calif., B.S.F., 1950.
Coombes, G. M., 485 Walnut St., Pomona, Calif.; Univ. of Calif., B.S.F., 1950.
Gohr, C. R., Chief Asst. Forester, Dept. of Forester and Firewarden, Los Angeles, California.
Malain, R. J., 5935 Fidler Ave., Bell flower, Calif.; Univ. of Calif., B.S.F., 1950.
Minter, B. E., 200 Paloma Rd., San Bernardino, Calif.; Univ. of Calif., B.S.F., 1950.
Mounts, J., 922 W. 30th St., Los Angeles, Calif.; Univ. of Calif., B.S.F., 1950.
Prescott, J. A., 17354 Cantlay St., Van Nuys, Calif.; Univ. of Calif., B.S.F., 1950.
Settle, W. H., 589 Mar Vista Ave., Pasadena, Calif.; Univ. of Calif., B.S.F., 1950.
Spencer, R., 5117 W. 116 St., Los Angeles, Calif.; Univ. of Calif., B.S.F., 1950.
Untereiner, D. E., 1089 San Pasqual St., Pasadena, Calif.; Univ. of Calif., B.S.F., 1950.

Upper Mississippi Valley Section

Junior Grade

Coyer, M. A., U.S.F.S., Grand Marais, Minn.; Univ. of Minn., B.S.F., 1950.
Dunnell, C. W., 619 19th St., Brainerd, Minn.; Univ. of Minn., B.S.F., 1950.
Lundberg, L. E., Gheen, Minn.; Univ. of Minn., B.S.F., 1950.
Pearson, R. A., 1204 Summit Ave., Detroit Lakes, Minn.; Univ. of Minn., B.S.F., 1950.
Raeber, P. C., 203 Aurora Ave., St. Paul, Minn.; Univ. of Minn., B.S.F., 1950.
Sandberg, D. L., 2113 Como Ave., St. Paul, Minn.; Univ. of Minn., B.S.F., 1950.
Skok, R. A., 1654 Eleanor Ave., St. Paul, Minn.; Univ of Minn., B.S.F., 1950.
Trestrail, R. W., Center City, Minn.; Univ. of Minn., B.S.F., 1950.

Wisconsin-Upper Michigan Section

Junior Grade

Pearson, M. W., 2912 N. 79th St., Milwaukee, Wis.; Univ. of Minn., B.S.F., 1950.
Stekiel, R. J., 3451 N. Weil St., Milwaukee, Wis.; Univ. of Mich., B.S.F., 1950.
Strothmann, R. O., 2320 E. Rusk Ave., Milwaukee, Wis.; Univ. of Mich., B.S.F., 1950.

Candidates Elected

The following persons were elected to the indicated grades of membership by the Council on August 1, 1950.

Junior Grade

Adkins, F. E.
Amborn, E. R.
Anderson, J. W.
Anderson, R. L.
Anderson, R. W.
Bagley, L. J.
Bailey, W. F.
Bankus, A. E.
Banter, G. M.
Bealke, S. W.
Beckman, J. H.
Boughner, W. S.
Braddy, D. L.
Brewton, L. L., Jr.
Brown, C. E.
Burnham, H. M.
Cairns, F. E.
Carson, B. F.
Casamajor, P., (re)
Childre, R. W.
Church, J. B.
Compton, C. W.
Cook, R. W.
Cookingham, W. S.
Corbin, M. A.
Cumbie, J. D.
Dalen, R. S.
Darley, H. W.
DeLoach, H. G., (re)
Denison, J. M.
Evans, F. L.
Fagan, J. H.
Faure, G. T.
Fellman, J. A.
Fifield, C. E., (re)
Fisher, C. D.
Frazier, J. R.
Freeman, F. R.
Gandy, J. H.
Gashwiler, R. S.
Gray, R. L.
Greenlaw, R. E.
Grisez, T. J.
Guenther, K. W.
Gumpt, T. E.
Hanchett, W. C.
Hill, R. C.
Hough, E. C.
Issaneson, N. R.
Jensen, J. T., Jr.
Johnson, D. S.
Jones, J. H.
Keil, H. H.
Kern, C. P.
Koehn, F. W.
Kowski, F. H.
Krell, R. K.
Krouse, P. F.
Kuemmin, R. J.
Lane, W. N.
Liming, G. E.
Loeffler, J. R.
Lowther, M. E.
Lyon, T. J.
Mann, D. E.
Manzer, N. R.
Maris, A. R.
Maule, W. M.
McAllester, W. R.
McGaw, W. W.
McElroy, J. R.
Mims, J. K.
Neely, O. O.
Nelson, F. A., Jr.
Nelson, L. O.
Ohlson, V.
Ohman, J. O.
O'Neill, D. H.
Paisley, E. R.
Pearson, E. D.
Prater, L. J.
Price, F. E.
Price, J. H.
Radcliffe, W. A.
Range, J. E.
Ratcliffe, P.
Read, J. W.
Reid, J.
Reppeto, H. R.
Robinson, L. E.
Rosmond, F. B.
Roundtree, L. J.
Runkel, S. T., (re)
Russell, L. H.
Schofield, D. J.
Seale, J. W.
Sedgwick, J. F.
Sedlacek, A. G.
Smith, C. E., (re)
Stebbins, C. H.
Sterling, D. G.
Stevens, L. A.
Stickney, D. B.
Stone, W. N.
Sumrall, J. E.
Thacker, S. W.
Tobermann, J. R.
Touse, R. D.
Vester, C. A.
Vladimiroff, B. T.
Walker, C. H.
Walters, H. L.
Ward, G. A.
Weissenborn, K. R.
Westmoreland, L. R.
Wilcox, E. R.
Winn, M. H.
Woods, N. R.
Worthington, R. E.
Wykert P. V.
Ziemienski, C.

Member Grade

Anderson, L. M.
Bennett, H. D.
Cain, R. L.
Cooper, R. E.
Daniels, K. M., (re)
Howard, H. H.
Moll, W. P. (re)
O'Neil, W. J.
Rea, R. E.
Rennels, R. G.
Stier, R. E., (re)

Affiliate Grade

Badman, C. K.
Hawkins, N. V.
Holmes, J. L.
Nutt, C. C.
Stuart, J. N.
Webb, R. B.

Associate Grade

Andrews, R. W.
Roth, L. F.

New Members And Advancements

The new members and members advanced in grade who are listed below are eligible for participation in activities of the Society of American Foresters, including the meetings and projects of Sections, Chapters, Divisions, and Committees. They have submitted their applications for membership, properly endorsed, and have been declared eligible by the Council. By accepting this recognition, these members have indicated their desire to assist the Society in the fulfillment of its objectives.

Allegheny Section

Junior Grade

Eberhard, T. T., Langhorne, Pa.
Enright, L. J., Box 602, State College, Pa.
Merrell, J. O., 16 Bloom St., Danville, Pa.
Van Pelt, M. B., 333 W. Johnson St., Philadelphia, Pa.
Williams, G. H., East Ave., Mullica Hill, N. J.

Appalachian Section

Junior Grade

Harper, J. P., Box C., Andrews, S. C.
Reynolds, E. E., Va. Forest Service, Salem, Va.

Member Grade

Bartholomew, R. J., Va. Forest Service, Portsmouth, Va.
Ferguson, M. B., Summerville, S. C.
Howard, L. E., Box 220, Georgetown, S. C.

Affiliate Grade

Hale C. H., Riverside Mfg. Co., Murfreesboro, N. C.

Central Rocky Mountain Section

Junior Grade

Loerch, K. A., 1009 K St., Tekamah, Nebr.

Member Grade

Benson, R. J., U.S.F.S., Gunnison, Colo.
Rawie, C. D., 108 5th Ave., S.W., Aberdeen, S. Dak.

Central States Section

Junior Grade

Frye, J. R., P.O. Box 282, Wayne, Mich.
Hamalainen, Box 535, Harbor Springs, Mich.

Member Grade

Steidemann, R. W., U.S.F.S., Ironton, Ohio.

Columbia River Section

Junior Grade

Birch, H. E., Western Lane Forest Prods. Assoc., Veneta, Oreg.
Bryant, H. R., Crown Zellerbach Corp., Seaside, Oreg.
Jefferies, G. K., Box 882, Lakeview, Oreg.
Sim, J. R., U.S.F.S., Union Creek, Oreg.

Member Grade

Burwell, D. C., Row River Lbr. Co., Dorena, Oreg.
Poulton, C. E., Dept. of Animal Husbandry, Corvallis, Oreg.

Gulf States Section

Junior Grade

Johnson, L. R., Rt. #2, Richton, Miss.
Kalweit, E. Kirby Hotel, Honey Island, Texas.
Norman, D. R., 2130 5th Ave., Laurel, Miss.

Member Grade

Cooper, J. W., 303 Wellington Rd., Jackson, Miss.
Hottle, W. D., Springhill, La.
Phillips, W. T., Box 85, Merryville, La.

Affiliate Grade

Conerly, C. S., P.O. Box 188, Poplarville, Miss.

Inland Empire Section

Member Grade

Harlan, G. W., 1914 Eleventh Ave., Lewiston, Idaho

Kentucky-Tennessee Section

Junior Grade

Gates, P. J., 1132 Midland Drive, Kingsport, Tenn.
King, R. H., Box 51, Pineville, Ky.

New England Section

Junior Grade

Bork, J. H., 101 Pleasant St., Franklin, N. H.
Hart, S. G. V., Cons. Paper Corp., Port Menier, P. Q., Can.
Morrill, G. W., 13½ S. Spring St., Concord, N. H.

New York Section

Junior Grade

Brown, G. S., U. S. Soil Cons. Service, Hamburg, N. Y.
Sobel, H. S., 853 Riverside Drive, N. Y., N. Y.

Affiliate Grade

Jefferson, H. H., American Pulpwood Assoc., N. Y., N. Y.

Northern California Section

Junior Grade

Courtney, H., Box 23, Hoopa, Calif.
MacDougall, R. T., Box 304, Camino, Calif.

Affiliate Grade

Schuckert, E., State Div. of Forestry, Camino, Calif.

Northern Rocky Mountain Section

Junior Grade

Bauman, R. H., 1245 N. 29th St., Billings, Mont.
Dahl, J. M., 9 Lake St., Missoula, Mont.
Gillespie, R. E., Ant Flat Ranger Sta., Fortine, Mont.
Luger, J. L., Box 797, Libby, Mont.
O'Neil, C. H., 45 Appleway, Kalispell, Mont.
Standiford, A. A., 1610 Arthur, Missoula, Mont.
Weir, L. R., 1640 S. 8th St., W., Missoula, Mont.

Ozark Section

Junior Grade

Gallaher, H. G., Salem, Mo.
Nelson, A. L. C., Wilmark, Ark.

Affiliate Grade

Oliver, C. L., 711 E. Mill St., Malvern, Ark.

Southeastern Section

Junior Grade

Turner, E. R., Univ. Court Apts. Athens, Ga.
Wike, C. O., 951 Ponce de Leon Ave., Atlanta, Ga.
Williams, R. A., Jackson Lbr. Co., Lockart, Ala.

Member Grade

Lovingood, B. S., P.O. Box 2, Hosford, Fla.

Southern California Section

Junior Grade

Geis, A. F., 6451 Bellaire Ave., North Hollywood, Calif.

Southwestern Section

Junior Grade

Fleishman, W. J., Jemez Springs, N. Mex.
Pickett, G. S., Box 632, Grants, N. Mex.

Upper Mississippi Valley Section

Junior Grade

Drexler, R. E., Dallas Center, Iowa.
Meyer, J. D., 3626 28th Ave., S., Minneapolis, Minn.

Member Grade

Hosfield, R. W., Iron Range Res. & Rehabilitation Comm., Hibbing, Minn.
Vegheim, B. O., Big Falls, Minn.

Washington Section

Member Grade

Berry, F. H., 9611 45th Place, Berwyn, Md.

Wisconsin-Upper Michigan Section

Junior Grade

Doll, A. D., 1243 S. 76th St., West Allis, Wis.
Langenbach, C. A., Box 504, Eagle River, Wis.
Petry, R. A., Nekoosa Edwards Paper Co., Port Edwards, Wis.
Tappon, M. T., c/o Forest Protection Headquarters, Tomahawk, Wis.
Walker, F. R., 905½ W. Munising Ave., Munising, Mich.

Member Grade

Abbott, R. W., Univ. of Wisconsin, Madison, Wis.
Wilson, W. G., U.S.F.S., Moran, Mich.

Forestry News

Park Service-Reclamation Cooperative Agreement Approved

Relationships between the National Park Service and the Bureau of Reclamation in the planning and development of recreation facilities on water control projects are defined in a cooperative agreement between the two Interior agencies which has just been approved by Secretary of the Interior.

The terms of the agreement are based on more than a decade of experience, during which the National Park Service has acted as advisor to and planner for Reclamation on the recreational aspects of water control projects.

The most important provisions of the new agreement call for:

1. Early information to the Park Service at regional levels regarding all projects to be investigated and all projects authorized for construction by the Bureau of Reclamation.

2. Early consultation, during the planning stages, so that the Park Service may advise on the location of roads, structures and other elements of construction, both for appearance and to obtain maximum recreational benefits.

3. Recreational surveys by the Park Service, and the preparation of reports on the recreational potentialities; Service recommendations concerning recreational developments; and the furnishing of preliminary and, when necessary, detailed plans and estimates of capital costs, for recreational developments, as well as operation and maintenance costs on Bureau of Reclamation projects.

4. Park Service preparation of estimates of potential recreational benefits, in money terms, for the use of the Bureau of Reclamation in determining the share of the "joint costs" of its projects allocable to recreation and in justifying recreational developments.

5. Inclusion in Bureau of Reclamation reports of estimates of costs of a project, costs recommended by the Park Service and approved by the Secretary as reasonable federal expenditures, for both detailed planning and construction of recreational developments, on a non-reimbursal basis.

6. Advances from the Bureau of Reclamation to the Park Service to cover costs of planning work requested by the Bureau.

7. Park Service conduct of negotiations with other agencies, federal, state, or local, for the ultimate administration of recreational facilities on those projects not considered of such national significance as to warrant permanent administration by the Service.

8. Continuance of arrangement for administration by the Forest Service, Department of Agriculture, of recreational facilities on projects wholly or largely within national forests.

9. Retention by the Bureau of Reclamation of responsibility for the control and utilization of project waters, as well as for dams and appurtenant works and lands immediately surrounding them which are considered necessary in order to meet this responsibility.

"On you, JAMES WALTER GIRARD, lumberman, logging engineer, practicing forester extraordinary; distinguished alike for your knowledge of the forest and the manner in which trees build merchantable sawlogs; in recognition of your services to the forest industry of our state and nation, and for your interest in the training of young foresters in the field techniques of your profession, by virtue of the authority vested in me by the Board of Regents, I confer the degree of Doctor of Science, honoris causa, with all of the privileges and honors thereto appertaining, in testimony thereof you will receive the diploma of the University and be vested with the hood appropriate to your degree." These are the words of President Buchanan of the University of Idaho (right) conferring the degree upon Mr. Girard (center). D. S. Jeffers, dean of the School of Forestry and Mr. Girard's sponsor stands at the left in a brief ceremony at the commencement exercises at Moscow, Idaho, June 5, 1950.

Arkansas Grants First Forestry Degree

On May 22, Arkansas A & M College gave its first 4-year forestry graduate, J. Lynn Corday, a Bachelor of Science degree with a major in forestry. The Forestry Department, under H. H. Chamberlin, has recently been reorganized to give a four-year major in forestry. The 1949-50 enrollment of 63 students is expected to be swelled by a large enrollment of freshmen in the fall.

Michigan Tries Machine Planting on Upper Peninsula

Fall planting in upper peninsula forests of Michigan will employ tree planting machines for the first time this fall. Before the regular fall planting season, machines also will be used for making scalps in rough terrain where hand labor previously did the entire job.

Practically all the 6.5 million seedlings set out last year in Michigan state forests were hand-planted. The new mechanical tree planter has undergone a series of field tests, and with a few revisions it will serve as a model for additional machines to be constructed at the Roscommon forest fire experiment station. The planter was designed by T. E. Daw, assistant state forester. It has a curved blade which hydraulically lowers and raises to clear individual planting spots. It is similar to commercially made planters in that packing wheels follow and press the dirt around seedling roots.

Daw reports a more expensive rotating fin unit has been temporarily discarded as the result of the recent tests. The whirling fins accomplish the objective of scooping out shallow planting holes but fail to do any better job than the curved blade unit.

State Forester Dewitt Nelson of California, left, presents a bronze plaque for outstanding public service to Frank Rehm, vice president, Shell Oil Co. The company joined in a campaign in 1924 to prevent forest fires, and for the past 25 years has been active in anti-fire publicity in the western states. A similar award was made to Charles P. Skouras, president of National Theatres for outstanding contribution to the cause of forest fire prevention through Fox West Coast and other motion picture theatres. Each year over 500 theatres have used motion picture trailers carrying a strong fire prevention message.

American Forestry Association To Meet With Canadian Forestry Association in October

Commemorating its 75th anniversary, the American Forestry Association is joining with the Canadian Forestry Association which is celebrating its 50th Anniversary in a joint annual meeting at Eagle River, Wis. October 9, 10, and 11. The meeting will constitute a "Grass Roots Conservation Caravan." With headquarters at the Trees for Tomorrow Conservation Camp, members and guests of both associations will visit the Nicolet National Forest, Gagen Experimental Forest of Consolidated Water Power and Paper Co., Star Lake Plantation, National Container Corporation forestry demonstrations, and industrial plants.

Local arrangements and program are being handled by a committee of Wisconsin persons headed by Folke Becker, president of Rhinelander Paper Co. Other members of the committee are D. Clark Everest, chairman of the board, Marathon Corp., Ernest Swift, director, Wisconsin Conservation Department; and Victor Isola, assistant regional forester, U. S. Forest Service.

Handbook on Alaska Trees

Because of an increased interest in the natural resources of Alaska, the Forest Service revised the *Pocket Guide to Alaska Trees*.

Originally issued in 1929, the handbook was written by Raymond F. Taylor, forester in charge, Alaska Forest Research Center, Juneau, and Elbert L. Little, Jr., Forest Service specialist in dendrology.

The handbook points out that Alaska has 30 species and two important varieties of native trees. All Alaska tree species except three shrubby species of willow and two varieties of paper birch occur in some part of the United States. Nineteen of the Alaska tree species grow wild as far south as California, and seven species are widely distributed in Canada and northeastern United States.

Nearly all commercial timber of Alaska, the handbook states, is produced from nine species: white spruce, Sitka spruce, western hemlock, mountain hemlock, western redcedar, Alaska cedar, balsam poplar, black cottonwood, and paper birch.

For each species, the handbook gives common scientific names, a nontechnical description, notes on size, habitat and economic importance.

Biltmore Alumni Hold Reunion

Alumni of the Biltmore Forest School gathered in May at the site of America's first forestry school to commemorate Dr. C. A. Schenck, founder. A tablet was dedicated in his honor.

Dr. Schenck, now 83 and living in Lindenfels, Germany, was unable to attend the reunion, but sent a message to the group. The school was established in 1898 at Biltmore, N. C. on the estate of George W. Vanderbilt for whom Dr. Schenck succeeded Gifford Pinchot as consulting forester. The area is now part of the Pisgah National Forest. From 1909, until it was finally abandoned in 1913, the school was a traveling institution with students gaining first hand experience in the forests of the East and Lake States and in Europe.

Alaska Pulpwood Award Amended

The preliminary award of 1½ billion cubic feet of Alaskan pulp timber to the Ketchikan Pulp and Paper Company has been modified so that the company will have until August 2, 1951, to qualify for final purchase of the timber.

Under a preliminary award made on August 2, 1948, the company was required to meet certain qualifications for final purchase of the timber. The date for final award has now been extended a total of two years so the company will have additional time to complete arrangements for construction of a sulphite pulpmill using the magnesium base process.

Commercial application of the magnesium base process is under development at the Weyerhaeuser Timber Company's plant in Longview, Wash. Difficulties which have arisen in applying the process on a commercial scale make it impracticable for the Ketchikan Company to complete the final design for its plant at this time.

The Forest Service agreed to the time extension because the magnesium base process eliminates all possibility that pulpmill waste materials might pollute the ocean water and damage the Alaskan fishing industry.

The initial pulpmill, to be built at Ward Cove, Ketchikan, Alaska, will have a daily capacity of 300 tons of pulp. The 1½ billion cubic feet of timber which the Ketchikan Company has agreed to buy will supply a pulpmill with a daily capacity of 525 tons per day for 50 years.

Integrated Woodland Management Example in South Carolina

The town of Bethune, S. C. has been encircled with good forestry. Vern Cutler, assistant forester, South Carolina State Commission of Forestry, has developed a local example of forester, landowner, sawmill operator, pulpwood operator, and farm tenant forestry cooperation.

As a result of one operation on which a sawmill operator cut low stumps and went high into the tree for his logs, a pulpwood operator utilized tops, damaged trees and thinnings, and farm tenants worked up limbs and branches for fuelwood, sixteen similar jobs were performed for seven more landowners. Now every road near Bethune passes by a selectively cut stand of timber showing complete utilization similar to that depicted on the cover of this issue of the JOURNAL OF FORESTRY.

West Virginia Group Opposes Forest Regulation

In its annual meeting on June 27, 1950, the West Virginia Forest Council approved the following resolution by a unanimous vote of the membership present:

WHEREAS the membership of the West Virginia Forest Council believes in the right of individuals to hold property as free citizens, and

WHEREAS the right of ownership would be impaired and free enterprise threatened by State or Federal regulation which would put a government agency in control of the supply of raw material to a basic industry

WHEREAS the membership of the Forest Council has faith in the land owners of West Virginia and believes that they can and will practice the form of forest management that will be most beneficial to themselves and to their State and to the country as a whole

WHEREAS the membership of the West Virginia Forest Council wishes to guide and direct the people of the State of West Virginia and of the United States of America away from any trend toward State Socialism

NOW, THEREFORE, BE IT RESOLVED That the West Virginia Forest Council will, through its Board of Directors and through its Executive Committee, actively oppose the principle of State or Federal regulation of private forests and State or Federal legislation looking to the establishment of this principle.

Following the adoption of this resolution it was voted by the membership to send copies to all members of the State Legislature, all West Virginia senators and representatives in Congress and to the National Lumber Manufacturer's Association.

FAMED OLD BILLY ENTWISTLE, 86, first fire warden in all the West, who started his career of keeping fires out of the woods back in 1906, today delights in showing younger generations what to do. Entwistle, third from right, shows three Cub Scouts how fire-free areas come back fast into new, young trees. He points out a vast tree farm in Washington state where a vigorous stand of second-growth Douglas fir and West Coast hemlock is growing into sawlogs.

Eastern Forestry Association Formed

The Mid-Hudson Forest Products Cooperative, Inc., of Kingston, N. Y., dissolved its business to become the newly organized Eastern Forestry Association, Inc., with headquarters in New Paltz, N. Y., according to Daniel Smiley, Jr., president.

The change in the form of the organization was made to permit timber operators, wood using industries, and conservation minded individuals to become members. Under the cooperative form of organization membership was limited to those growing forest products. Since the association believes that the wood utilizer is the key to forest management the board of directors wanted them to become an integral part of the organization.

The overall program is being directed by Stanley Mesavage, industrial forester and manager, formerly chief forester of the New England Forestry Foundation.

Staffed by foresters, the association is designed to serve New York, northeast Pennsylvania, northern New Jersey, western Massachusetts, and southern Vermont. Its forestry program includes detailed forest management planning and investigations, log and lumber production, applied silviculture, and the marketing of forest products.

Anomala Control Tests Completed

Field tests with new insecticides, aimed at controlling the anomala beetle which attacks jack and red pine, have ended at the Michigan Conservation Department's Higgins lake forest but no definite answers as to the effectiveness of the experiment are expected for at least a year. Anomala beetle-infested pine are prevalent throughout the north central lower peninsula.

First observations indicate destruction of 90 to 95 percent of the beetles in a selected 80-acre state forest tract, but further checks are necessary.

The spraying crew experimented on small strips with chlordane, dieldren, and "1189," insecticides not previously tried on the anomala beetle.

Foreign Wood Products Industries Described

An issue of *Esso Oilways* (Vol. 3, No. 2) published by Esso Standard Oil Company, is devoted almost exclusively to articles dealing with wood products industries abroad. It includes an industrial analysis of pulpmaking in Sweden, a case history of a British woodworking machinery plant, a case history of Norwegian ski making, a story on industrial development of Brazilian hardwoods, a case history of Canadian woods operations, and a study of the wood using industries of Finland.

Texas Forestry Leader Dies

On August 2, W. Goodrich Jones, 89, pioneer in southern forestry died at his home in Waco, Tex.

It was through his enthusiasm and efforts that the Texas Forestry Association was formed in 1905. He served as the association's first president, and until his death was president emeritus.

One of the first outstanding achievements of the association, through the leadership of Mr. Jones, was the enactment in 1915 of state legislation that created a Texas Department of Forestry, now known as the Texas Forest Service, a part of the Agricultural and Mechanical College System.

In honor of half century of service to forestry and forest conservation, a state forest of 1700 acres was formally dedicated as the W. Goodrich Jones State Forest in 1949.

Brown Co. Gives Tree for Tree

Gifts of tree-planting stock to all producers selling pulpwood to the Brown Company, Berlin, N. H., have been announced by Laurence F. Whittemore, president of the company. Spruce seedlings will be distributed free on the basis of tree for tree for each tree purchased by the company in the form of pulpwood.

This announcement was made at a forestry field day recently sponsored by the company for pulpwood users and producers, conservation officers, foresters, farmers, and lumbermen.

The offer is part of the company's program of improved forestry practice and intelligent utilization of forest resources. In making the announcement, Mr. Whittemore observed that "our forests, if intelligently handled, are as great an asset to us here in New England as are the coal mines to Pennsylvania and the iron mines to Minnesota. But while coal mines exhaust themselves as they are worked out," he said, "our timberlands, if properly managed, will renew themselves again and again."

Under the plan, a producer supplying Brown Company with 500 cords of pulpwood would be entitled to 4,000 free spruce seedlings with which he can replace the trees he has harvested. Brown Company's foresters give personal assistance to woodland owners and farmers by actual visits to their wood lots, marking trees for cutting, and giving advice on tree planting and culture to insure maximum productivity.

The Forestry Field Day included visits to several Brown Company plantations and timberlands.

INDIANS SIGN MANAGEMENT PLAN. The Turtle Mountain Indian Tribal Council at a recent meeting signed and adopted a forest management plan covering 35,000 acres of tribal lands. This action on the part of the Indians will have a far-reaching effect on their income and wood supply, and will indirectly effect the land owners in surrounding areas.

The forest plan of management provides for a definite program of selective cutting under the direction of a forester; and the logs will be converted into lumber, posts, and fuelwood. The tribe plans to purchase a sawmill. At the present time the principal use of the woodland by the Indians is for fire wood, poles, house building, and fence posts for sale. Also, they have a hayrack building industry.

The plan also provides for forest protection, maintenance of wildlife, and development of reforestation where trees may be used to a greater advantage than other crops.

Shown above, at the signing of the agreement are, left to right: C. N. Nelson, state forester of North Dakota; Norbet Davis, chairman, Turtle Mountian Indian Tribal Council; Edward Jollie, council member; Floyd T. Ryan, farm forester; C. H. Beitzel, superintendent, Turtle Mountain Indian Agency; Ray H. Claymore, council member.

RUSSELL STADELMAN, chief forester for Nickey Brothers, Inc., of Memphis, Tenn. recently completed a trip around the world in search of new woods. He left Memphis in early April and arrived back in late June. In the Philippine Islands he spent 6 weeks visiting three of the main islands. He also visited with Director Florencio Tamesis, Philippine School of Forestry at Los Banos. Proceeding to North Borneo he spent 8 days on visits to several sawmills and logging camps. Arriving at Bangkok, Thailand (Siam) he conferred with Dr. M. A. Huberman, chief, Forestry and Forest Products Working Group for Asia and the Pacific, FAO and Khit Suwanasudi, chief, wood technology division, Royal Siamese Forestry Department. He then went on to London to visit several veneer factories.

Shown above is the faculty of the Philippine School of Forestry with whom Stadelman conferred. Left to right: R. T. Cortes, wood technology; C. Galutira, surveying; G. Zamuco, management; Florencio Tamesis, dean; Harold Cuzner, forester in charge; and M. M. Oro, silviculture.

Canadian Publications Listed

One hundred and sixty publications are included in a list issued by the Forest Products Division, Forestry Branch, Department of Resources and Development, Ottawa.

Reports, technical bulletins, and reprints of articles and papers listed cover a very wide range of fundamental research and specific data.

The publications are listed under twelve separate headings, dealing comprehensively with the mechanical and physical properties of wood, preservative treatment and protective coatings, the pathology and chemistry of wood, and with numerous phases of wood preparation and utilization.

Lumber seasoning, plywood manufacture, laminated construction, adhesives, and dielectric heating, and various problems of waste utilization, are but some of the many subjects extensively reported.

TREE FARMS operated by private forest industry in Oregon and Washington were the center of interest for a party of British Columbia forestry officials during June. The group spent a busy 12 days in June on inspection tours of forestry programs in action.

Two government officials and 21 representatives of the British Columbia timber industries studied the possibilities of an alternate plan of forest management to the one now in effect in British Columbia. Their attention was focused on long range management plans, logging methods aimed at more intensive utilization, taxation problems, reforestation techniques and fire protection programs. Observations indicated several possibilities for application on provincial timberlands.

Shown at left is Nelson Jeffers, branch forester of the Weyerhauser Timber Company's Longview operation, pointing out rapid growth of young Douglas-fir to E. T. Kenney, minister of lands, British Columbia.

Hole Digger Converts to Saw

The "Earth Drill" just announced by McCulloch Motors Corporation of Los Angeles, is a new 5-horsepower, gasoline-powered post-hole digger reported to be capable of drilling at a high rate of speed in any type of earth or clay. It is completely portable, requiring no tractor or vehicle for its operation.

An unusual feature of the Earth Drill is that it can be converted into a standard McCulloch chain saw in less than a minute, since the engine is the same unit used on the timber saw.

Weight of the two-man Earth Drill complete with 6-inch auger is only 79 pounds. A full-swivel coupling at the engine permits the auger to drill at any desired angle, and makes it possible to reverse the rotation of the auger. Other interesting features are: centrifugal clutch that automatically disengages the auger at idling speeds; kickproof automatic-rewind starter, diaphram carburetor to permit full-power engine operation in any position; and one-control operation. Augers of 6, 9, and 12-inch diameter are currently available.

Japan's Parks Chief Visits United States

Minoru Iijima, director of national parks in Japan, is making an 11-week study of this country's national parks.

Mr. Iijima, a leader in the field of park administration and land use in Japan, was selected by the United States Supreme Commander for the Allied Powers to make the study in the belief that policies and methods of national park administration in the United States might be helpful in rehabilitating Japan's national park system.

Newton B. Drury, director of the National Park Service, pointed out that SCAP's Public Health and Welfare Section, the Army unit in charge of Japanese recreational work, believes that reconstruction of the national park system is important to Japan's economic recovery and that, particularly since the country is overcrowded and possesses few other healthful recreational facilities, national parks offer an effective means of improving the physical and mental well-being of the Japanese people.

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New Northwest Game Chief

William Huber has ben named chief of wildlife management for the Pacific Northwest region of the U. S. Forest Service. He replaces Glenn Mitchell who retired from the Forest Service May 31.

The new wildlife chief comes to the Pacific Northwest from the Forest Service regional office in Philadelphia, Pa., with an extensive background in game and fish work. He majored in wildlife management at the New York State College of Forestry where he was graduated in 1934. He was first employed by the Forest Service as a junior forester on the Desoto National Forest in Mississippi. In 1936 he took a year's training in game management on the Pisgah national game preserve in North Carolina. Later he was assistant ranger on the Pisgah National Forest and ranger of the Tellico ranger district of the Cherokee National Forest in Tennessee.

Huber was transferred back to the Pisgah forest as ranger in 1944 where he had charge of the Pisgah game preserve and the Sherwood wildlife area. In 1948 he went to Philadelphia in the division of information and education of the regional office.

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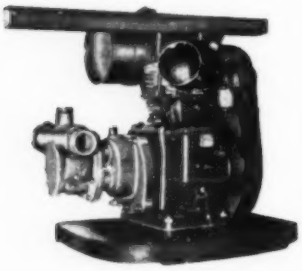

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Program Packet for Clubs

American Forest Products Industries, Inc. is distributing a kit of three short talks and a panel discussion on forestry for use at meetings of women's clubs, garden clubs, civic organizations, and similar groups. Copies are available from the AFPI office, 1319 Eighteenth Street, N.W. Washington 6, D. C.

Enoch W. Nelson (1889-1950)

Enoch Wesley Nelson, member of the Colorado A & M college forestry faculty since 1936, died June 25. Mr. Nelson, had been in failing health for some time but had finished the spring term at the college and on June 13 attended a forestry range field day.

Born Oct. 28, 1889, at Red Oak, Iowa, he spent his boyhood at Lincoln, Neb., and in 1913 received a bachelor's degree in forestry from the University of Nebraska. Two years later he received a master's degree in plant ecology from the university.

He was appointed an assistant in experimental agronomy at Nebraska University for the 1916-17 term while he studied for a doctorate. At the end of that term he enlisted in the 10th Engineers and served 18 months overseas with the 10th and 20th Engineers.

In 1919 he took a position with the U. S. Forest Service on range research and administrative work. In 1933, he joined the Montana State University faculty as associate professor of range management.

Coming to Fort Collins April 1, 1936, he was first employed in the agriculture division of the college, before a separate forestry division was established. He established a grazing and range management deperatment in the experiment station. That department was later expanded into a teaching and research department in the forestry division. His major field was range and pasture management and he was the author of many articles based on research work in range management and the rehabilitation of crop lands.

J. Lee Deen, dean of the forestry division, in a tribute to Mr. Nelson, stated, "His death is a great loss to the college. He was well known to ranchers and stockmen of this area as well as to A & M students and faculty members. The research he had done was of particular value to livestock growers of the Rocky Mountain region."

Resources Committee Named

Ralph Carr, of Denver, former governor of Colorado and an authority in the field of water resource problems of the western states has been named chairman of the Natural Resources Committee of the Chamber of Commerce of the United States.

The 39-man committee contains a representation of the extractive natural resources industries and the related fields of energy supply, conservation, and public lands. The first meeting of the committee is scheduled for early November.

In the renewable resources field, committee members are as follows:

Lumber, pulp and paper—Bertram E. Claridge, vice president, Hammermill Paper Co., Erie, Pa.; Abbott Fox, Abbott Fox Lumber Co., Iron Mountain, Mich.; A. J. Glasgow, vice president and general manager, Brooks-Scanlon, Inc., Bend, Oreg.; Julian F. McGowin, secretary-treasurer, W. T. Smith Lumber Co., Chapman, Ala.; W. S. Rosecrans, president, W. S. Rosecrans, Inc., Los Angeles; Rand N. Stowell, Timberlands, Inc., Dixfield, Maine; O. T. Swan, secretary-manager, Northern Hemlock and Hardwood Manufacturers Association, Oshkosh, Wis.

Water resources and reclamation—Ralph Carr, Denver; Charles W. Deterding, Jr., county executive, County of Sacramento, Sacramento, Calif.; Millard G. Scott, Huron, S. Dak.; Paul Weir, general manager, Atlanta Water Works, Atlanta, Ga.

Grazing and public lands—Frederick P. Champ, Logan, Utah; Forrest E. Cooper, counsel, Interstate Association of Public Land Counties, Lakeview, Oreg.; Floyd W. Lee, president, Fernandez Co., Albuquerque N. Mex.; E. L. Moulton, president, Charles Ilfeld Co., Albuquerque, N. Mex.; William B. Wright, Marys River Ranch, Deeth, Nev.

Conservation—Paul Clement, secretary, Minnesota Commercial Men's Association, Minneapolis, Minn.; Edward J. Condon, assistant to the president, Sears, Roebuck and Co., Chicago, Ill.

Lott Named Extension Forester

Edgar J. Lott has been promoted to the position of state extension forester of Indiana. Mr. Lott was formerly one of four district extension foresters. He replaces J. L. VanCamp who resigned to become general manager and vice president of the Canadian Forestry Association.

A University of Michigan graduate, Lott has been with the Indiana Extension Service since 1944 and for the past several years has been in charge of the Rockville District. As state extension forester, he will be responsible for all forestry extension work within the state.

Forester to Manage M & M Plywood Lands

Paul H. Logan, logging engineer for the Northern Region, U. S. Forest Service has accepted a position with the M & M Plywood Corporation at Portland, Oreg.

The M & M Plywood Corporation operates plants in Longview, Wash.; Portland, Albany, and Idanha, Ore.; and Eureka, Calif. Mr. Logan will be in charge of the timber department involving the management of extensive timber tracts held by the company in Oregon and California.

He is a graudate of Cornell University, 1926, and has been with the Forest Service since 1927. In 1942 Mr. Logan went to Alaska as resident engineer on Kosciusko Island where spruce timber for aircraft production was logged from the Tongass National Forest. He returned to the regional office in Portland in 1943 and four years later came to Missoula to join the Division of Timber Management as logging engineer for the Northern Region.

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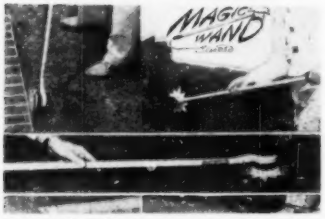

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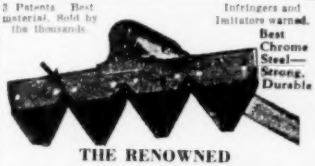

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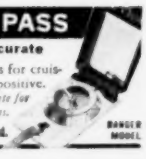

Big Bend Park Dedication

The dedication of Big Bend National Park, which had been scheduled for October 11, will be postponed until next spring or later, if the recommendation of Secretary of the Interior Oscar L. Chapman and Representative Ken Regan of Texas is accepted. The decision to recommend a postponement was based on the conviction that the international situation, requiring the presence of the President and members of his cabinet in Washington, made such action desirable.

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Abstracts Available

The prevention of deterioration abstracts, published by the National Research Council, 2101 Constitution Avenue, Washington 25, D. C., are offered for subscription on a yearly basis. Abstracts are classified under the headings: Biological agents; Electrical and electronic equipment; Fungicides and other toxic compounds; Lacquers, paints, and varnishes; Leather; Lubricants; Metals; Miscellaneous; Optical instruments and photographic equipment; Packaging and storage; Plastics, resins, rubbers, and waxes; Textiles and cordage; and Wood and paper. One volume of approximately 2,000 loose-leaf pages is published each year in monthly issues. Subject and author indexes are compiled annually to cover abstracts issued from July through June. The yearly rate of $50 includes two sturdy binders and index tabs.

An advance list, a monthly bibliography of all reports received in this field, is available for $10 a year.

Wieslander, Consulting Specialist Roberts, Chief of Economics

Appointment of A. E. Wieslander to the post of consulting specialist on land-use problems and of Eugene V. Roberts to succeed him as chief of forest economics research is announced by the California Forest and Range Experiment Station, U. S. Forest Service.

Mr. Wieslander is known throughout California for the investigations of forest resources made under his direction during the past 30 years. These studies have resulted in a series of widely used maps showing the vegetation of the California Region.

Objectives of the new post are to test and improve methods of appraising the quality of wild lands and to assist local, state, and federal agencies in determining the kind of land use that will make the maximum economic contribution to the region.

Mr. Roberts has had 24 years of experience in forest management and research for the Forest Service. This work has included assignments in southeastern and central United States, Washington, D. C., and the Virgin Islands. His most recent position has been as forest economist in charge of the forest survey at the Central States Forest Experiment Station, Columbus, Ohio. Much of the current forest economics research at the California Station is concerned with the forest survey.

Aircraft Prove Value in Fire Fighting

Forest Service officials are convinced that aircraft have proved their value in detecting and suppressing fires on national forests.

Last year, airplanes and helicopters flew 7,957 flights lasting a total of 10,548 hours in Forest Service fire control work. These aircraft transported 8,770 men and carried 1,318,000 pounds of cargo.

According to C. A. Gustafson, chief, Division of Fire Control, the Forest Service owns 16 airplans. The Service also hires or charters planes and helicopters to transport men and cargo for emergency fire fighting.

Heavier types of airplanes are used for hauling cargo and dropping smokejumpers, and lighter types for reconnaissance work. When men or cargo need to be hauled long distances, the Service charters large commercial aircraft.

At one time, it was thought that helicopters could not be depended upon for operations from landing spots at altitudes exceeding 3,000 to 4,000 feet. Reduction in their empty weight and development of special piloting techniques, however, have overcome this limitation to a great extent. Mr. Gustafson stated that a helicopter has delivered a fire fighter to a mountain top 9,000 feet above sea level when flying conditions were ideal and that helicopters now regularly land at 6,000-foot elevations. Having a skilled pilot at the controls is one of the most important factors.

Correction

On page 519 of the July JOURNAL OF FORESTRY a news item describing chemical treatment of standing trees to facilitate peeling for pulpwood, it is reported, "a gallon of the weak solution will treat from 300 to 500 cords." The statement should have read,"a gallon of the weak solution will treat from 300 to 500 *trees*."

Positions Wanted

Graduate forester, 28, experience with U. S. Forest Service and tree service company, desires permanent position with private forest enterprise or wood products company. References and details on request.

Box K, Journal of Forestry, Mills Building, Washington 6, D. C.

Horticulturists Meet in October

The Congress of American Horticulture will be held at East Lansing, Mich. October 26, 27, and 28.

The program will include discussion of proposed uniform nomenclatural and registration practices, a new scientific low-priced color standard chart, a reference book on horticultural organizations and personnel, a proposal for an advisory committee to assist in making the *Horticultural Manual* and *Encyclopedia* of the Bailey Hortorium completely authoritative.

Markwardt, President of American Society for Testing Materials

L. J. Markwardt, assistant director, U. S. Forest Products Laboratory, Madison, Wis., was elected president of the American Society for Testing Materials at the Society's 53rd annual meeting in Atlantic City N. J., the week of June 26.

Association Executives to Meet in September

The second annual conference of the Council of State Forestry Association Executives will be held at Lake Winnipesaukee, near Concord, N. H. September 10, 11, and 12. Program arrangements are being made by Lawrence W. Rathbun of the Society for the Protection of New Hampshire Forests and Harris Reynolds, Massachusset Forest and Parks Association, and chairman of the council.

The council was formed in 1949 at a meeting called by the American Forestry Association at Wannanish, N. C. Purpose of the group is to serve as a clearing house for association activities and to advance forestry through cooperative planning and discussion of citizen group problems and programs.

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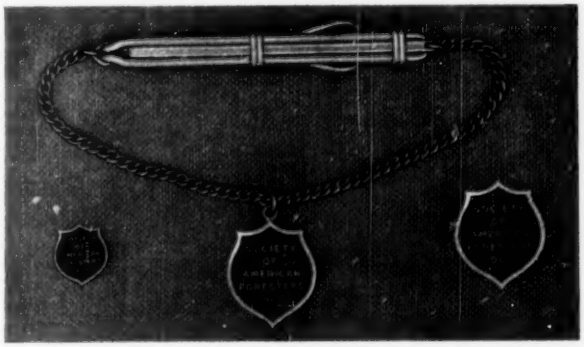

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More Tree Farms—North Dakota

Forty farmers were awarded Tree Farm certificates June 20 at Fessenden, N. D., in the state's second Tree Farm dedication. The meeting was held in conjunction with the North Dakota Flying Farmers and Ranchers convention.

All Tree Farms certified were of the shelterbelt variety. North Dakota, one of 28 states with Tree Farm programs in operation, was the first to certify shelterbelt woodlots. Like all Tree Farms, shelterbelts must be managed in accordance with sound forestry practices.

The 300 persons present heard E. L. Demmon, director of the U.S. Forest Experiment Station at St. Paul, credit the Tree Farm program with "stimulating additional shelterbelt planting in North Dakota."

Representing the governor, C. N. Nelson, president of the North Dakota School of Forestry, praised the farmers for their cooperative activity in tree growing. He said that the state will have available annually some five million seedlings for planting by farmers.

Others on the program were Fred J. Mohr, chairman of the Wells County Soil Conservation District and owner of the airport at which the ceremonies were held, and Floyd T. Ryan, state farm forester, who served as master of ceremonies.

Knopf Appointed Parks Advisor

Alfred A. Knopf, New York publisher, has been appointed to the Department of the Interior's advisory board on National Parks, Historic Sites, Buildings, and Monuments.

Mr. Knopf, who has long been interested in the preservation of both national park scenery and historic sites, is a member of the council of the Institute of Early American History and Culture, sponsored by the College of William and Mary and by Colonial Williamsburg. He will fill the vacancy created by the resignation of Dr. Waldo G. Leland, who recently retired also from the position of director of the American Council of Learned Societies.

Pulpwood Industry Replants 61,500 Acres

For the second consecutive year the southern pulpwood industry is responsible for having planted in excess of 60 million trees. The 1950 survey, made by H. J. Malsberger, forester for the Southern Pulpwood Conservation Association for the first time included the tree planting activities of those supplying pulpwood to the mills. These pulpwood producers account for the planting of 1½ million trees. The acreage planted is estimated on the basis of setting out 1,000 trees per acre.

The industry purchased 53½ million trees from the state forest nurseries and grew the remaining 8 million in company operated nurseries.

Nearly 43½ million of these trees were planted on lands owned by the pulpmills or producers. The remaining 18 million were contributed to small landowners to assist them in restocking worn out or idle farm and forest lands. The contribution to the landowner is an increase of 6½ million trees over the quantity donated by the industry last year.

Teacher Heads AFPI Department

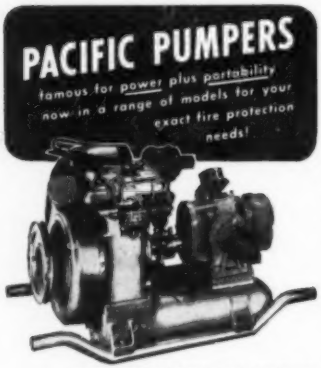
A former Kansas school teacher, Miss Alma Deane Fuller, has been named director of American Forest Products Industries' education division. Prior to her appointment, Miss Fuller served as national publicity representative for the American Junior Red Cross with offices in Washington, D. C.

Miss Fuller will work closely with educators, urban and rural youth groups, women's clubs, and other individuals and organizations interested in encouraging better woodland management and protection in the United States.

A native of Kansas, she served three years as a teacher in the public schools of that state, and later was assistant state Extension Service editor in charge of 4-H Club and home economics publicity. She is a graduate of the journalism department of Kansas State College.

Smokey Bear to Live in Washington, D. C. Zoo

Smokey, a 4-months-old black bear cub found in the Lincoln National Forest following a forest fire, was presented to the Washington zoo by the U. S. Forest Service in a ceremony held on June 30. Smokey is dedicated to the children of America as a symbol of fire prevention needs.



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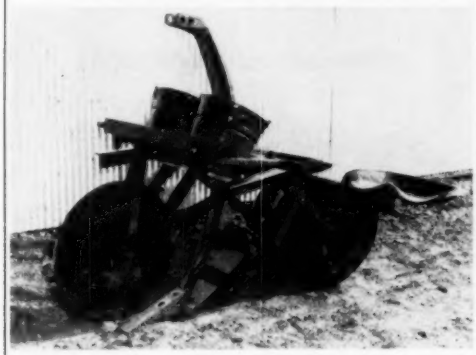

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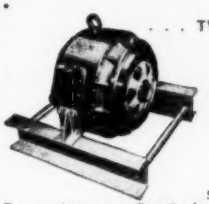

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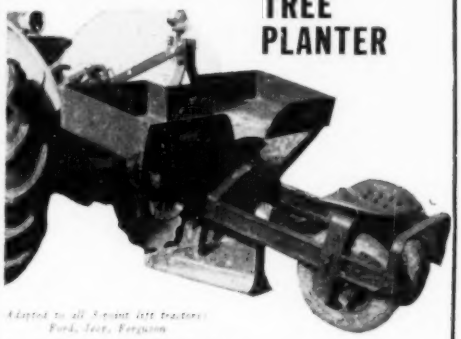

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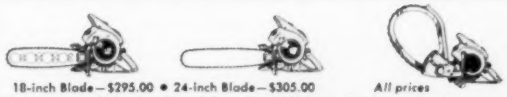

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